GEK-38313

SOUTHEASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY

OPERATORS MANUAL

PENN CENTRAL

CAR NUMBERS 270 THROUGH 399

READING CO.

CAR NUMBERS 9018 THROUGH 9031

TRANSIT SYSTEMS PRODUCTS DEPARTMENT

GENERAL ELECTRIC

10-26-77
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GEK-38313

INSTRUCTIONS

OPERATOR'S MANUAL
SEPTA
PENN CENTRAL - READING COMPANY

This publication covers electrically-powered, self-propelled, rail passenger cars.

The car road numbers are as follows:

Penn Central	Reading
Single Cars – 270 to 303	Single Cars – 9018 to 9031
Married Pairs – 304 to 399	

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

REV. 1 (4-74)

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NOTICE

The information contained in this manual is to familiarize operating personnel with the controls and indicators provided for proper operation of the General Electric SEPTA cars.

All operation of these cars should be in accordance with Reading Company or Penn Central Operating Instructions.

INTRODUCTION

This manual has been prepared for use by operating personnel on the new Southeastern Pennsylvania Transportation Authority cars built by General Electric for service on the Reading and Penn Central railroads. Section I describes the cars and lists the characteristics and data pertinent to their operation. Section II identifies the operating controls and indicators utilized by the engineman and train crew. Circuit breakers and switches are also identified. Section III contains the procedures for normal train operation. Section IV describes the operating subsystems on the cars and will provide operating personnel with a better understanding of the cars' capabilities. Section V is devoted to troubleshooting and gives procedures for moving the train should various types of equipment fail.

I. GENERAL INFORMATION

A. DESCRIPTION

Electrically powered by overhead catenary and of stainless steel construction, these cars are designed and built to provide safe, rapid, comfortable passenger service for the Southeastern Pennsylvania Transportation Authority. There are three types of cars; single cars, and A and B cars. Because certain items of equipment are shared between A and B cars, they must remain coupled into pairs of one A and one B car. Single cars may be operated singly or in trains. Pairs may be coupled into trains or operated as a married pair unit. Pairs and single cars may be coupled into trains.

Each single car or married pair unit is completely equipped for independent two-way operation - having a motor-alternator set, propulsion system, main transformer, air conditioning system, communications system, battery and battery charger, an air compressor and two operating stations. The major differences are (1) the single car carries a single car emergency stop group which the others do not, (2) the A car carries the voltage regulator, battery, battery charger, battery circuit breaker, motor-alternator set and its starting, exciting and running resistors, and the MA control panel which the B car does not, and (3) the B car carries the pantograph, cab signal equipment, air compressor, no motion panel, and the radio and PA amplifier which the A car does not. (All other underfloor equipment is common to all cars.)

Bus lines provide 11,000 VAC continuity between A and B cars in a pair. There is only one pantograph for each pair, located on the B car, with a high tension jumper running from the B car to the A car at roof top level.

Control for one car or a train of cars is transmitted via a trainline from the lead cab through the train. Connections for this trainline are made between the single cars and married pairs via a special electrical connection portion of the coupler and between the A and B cars in a married pair through the jumper cables.

Braking of these cars is performed by an electrically assisted air brake system in which brake cylinder air pressure is in turn controlled by metering main reservoir air to the brake cylinders from a control valve on each car. The signals for brake pressure are electrical and pneumatic and are passed between cars through a special electrical circuit in the couplers and via the brake pipe. Main reservoir air pressure is passed between cars via the main reservoir equalizing pipe.

Dynamic braking is assisted by air braking (except in emergency) automatically. Dynamic braking uses the main traction motors as generators to slow the train. The air brake system is fail safe and will automatically take over if something happens to the dynamic brake. The air brake system blends in by itself as the train approaches a stop and all stops are finally made with air brakes because dynamic braking fades out below 15 mph.

B. CAR DATA

DIMENSIONS AND WEIGHTS

Length of car over coupler	85 ft. 0 in.
Distance center to center of trucks	59 ft. 6 in.
Width over threshold	10 ft. 0 in.
Width of car body at seat cushion & shoulder line	10 ft. 6 in.
Maximum width of car body	10 ft. 6 in.
Minimum interior width of car body (24 in. to 30 in. above floorline)	10 ft. 0 in.
Height, rail to top of finish floor, at bolsters, new wheels	51 in.
Minimum radius of track curve with cars coupled	250 ft.
Height, floor to bottom of window glass line	35 in.
Height of window between glass lines	18 in.
Maximum height, rail to top of roof, new wheels, empty car	12 ft. 8 in.
Minimum vertical clearance in aisle inside car under low ceiling	6 ft. 7 in.
Minimum height, floor to headling at centerline of car	7 ft. 1 in.
Coupler height above rail	34 1/2 in.
Side door opening between door posts, minimum	35 in.

Minimum height, side door opening over floor	6 ft. 4 in.
Minimum height, end door opening over floor	6 ft. 5 1/2 in.
Maximum height, rail to top of clean air intake/braking resistors enclosures, new wheels, empty car	14 ft. 2 in.
Minimum width of end door opening	30 in.
Wheel diameter	32 in.
Maximum number of cars in train	16
Cars are designed for a maximum super-elevation of	7 in.
Track gauge (Nominal)	56 1/2 in.
Truck Wheelbase	8 ft. 6 in.
Pantograph locked down height, maximum	14 ft. 10 3/4 in.
Simulated load for performance testing purposes	19,530 lbs.
A.C. contact line voltage (25 cycle - Nominal)	11,000
A.C. contact line voltage (60 cycle - Nominal)	11,000/25,000

The average weight of a married pair of cars is 244,100 lbs. max. without passengers. The weight of a Single car unit for the PC is 127,500 and for the Reading is 128,250.

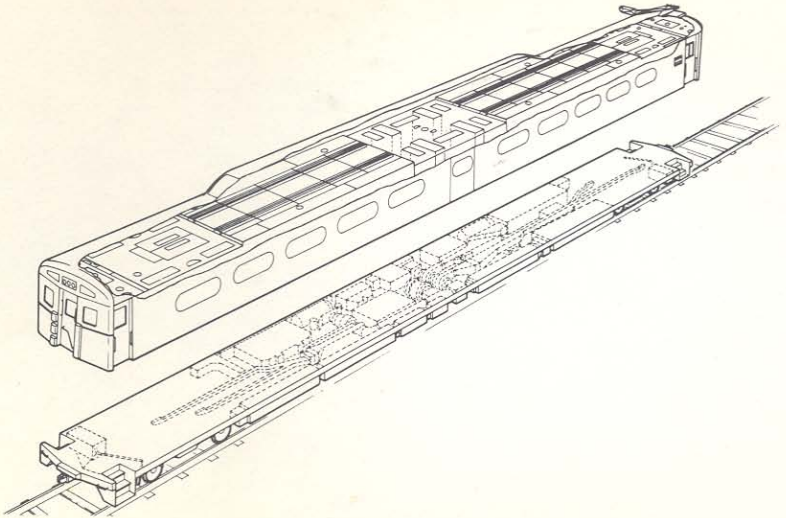


FIG. 1-1. SEPTA SINGLE CAR. E-18714

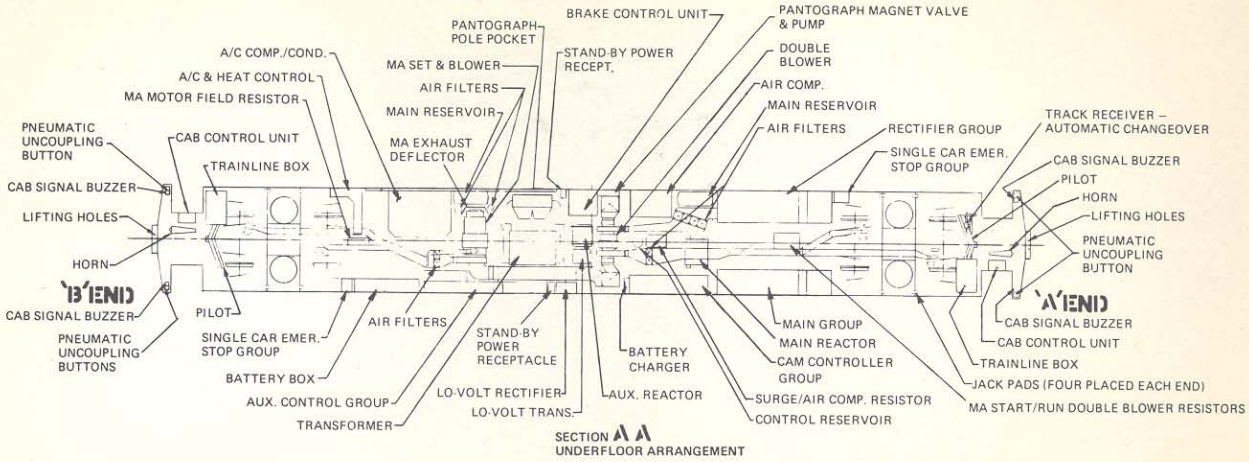


FIG. 1-2. UNDERFLOOR LAYOUT SINGLE CAR. E-19280

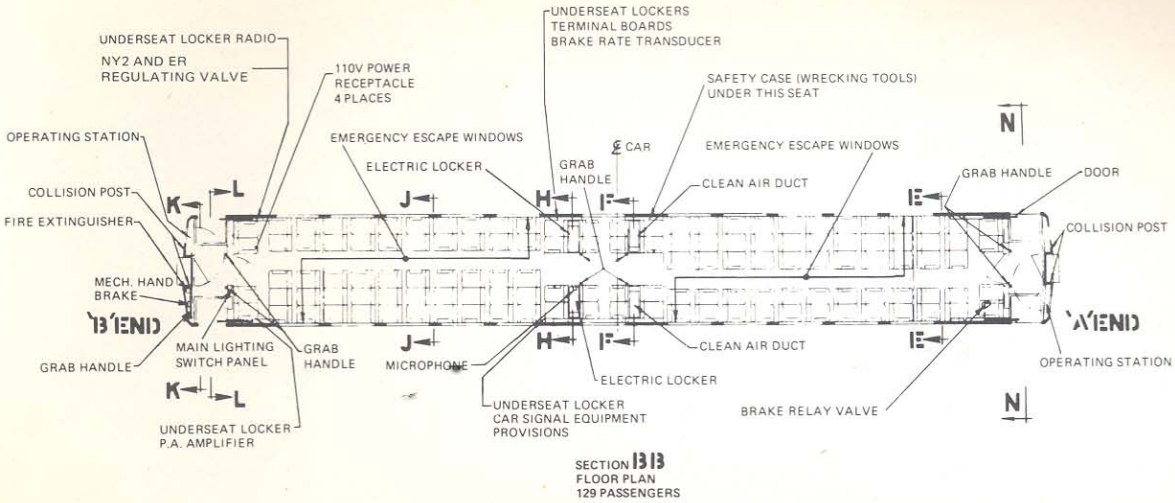


FIG. 1-3. INTERIOR CAR ARRANGEMENT SINGLE CAR. E-19288

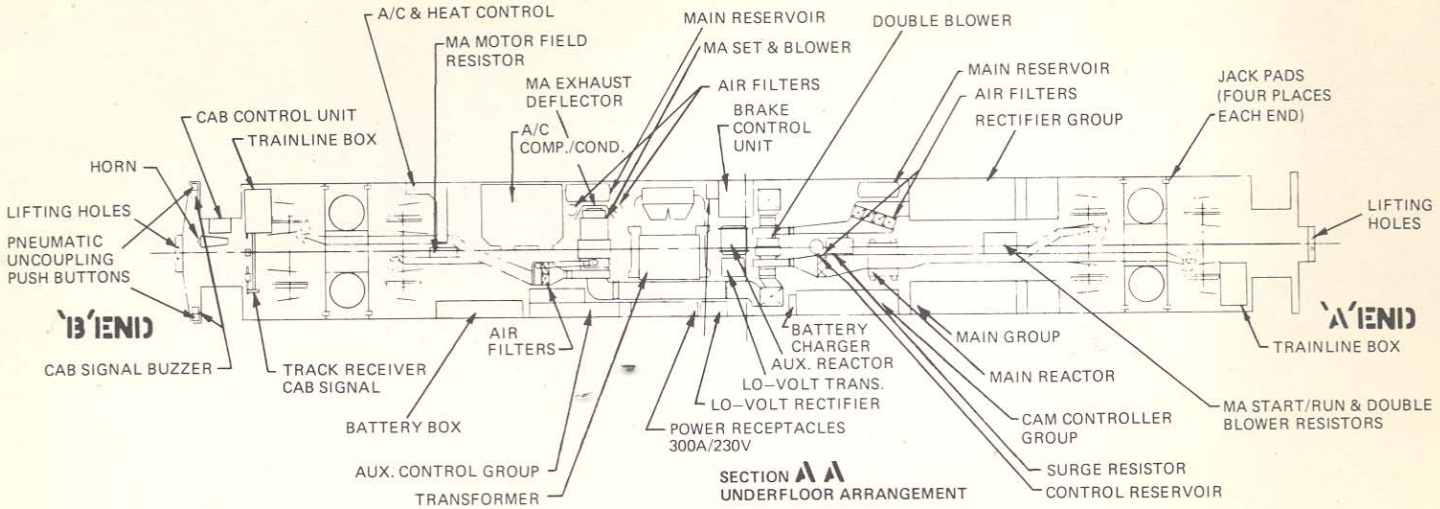


FIG. 1-4. UNDERFLOOR ARRANGEMENT "A" CAR. E-19281

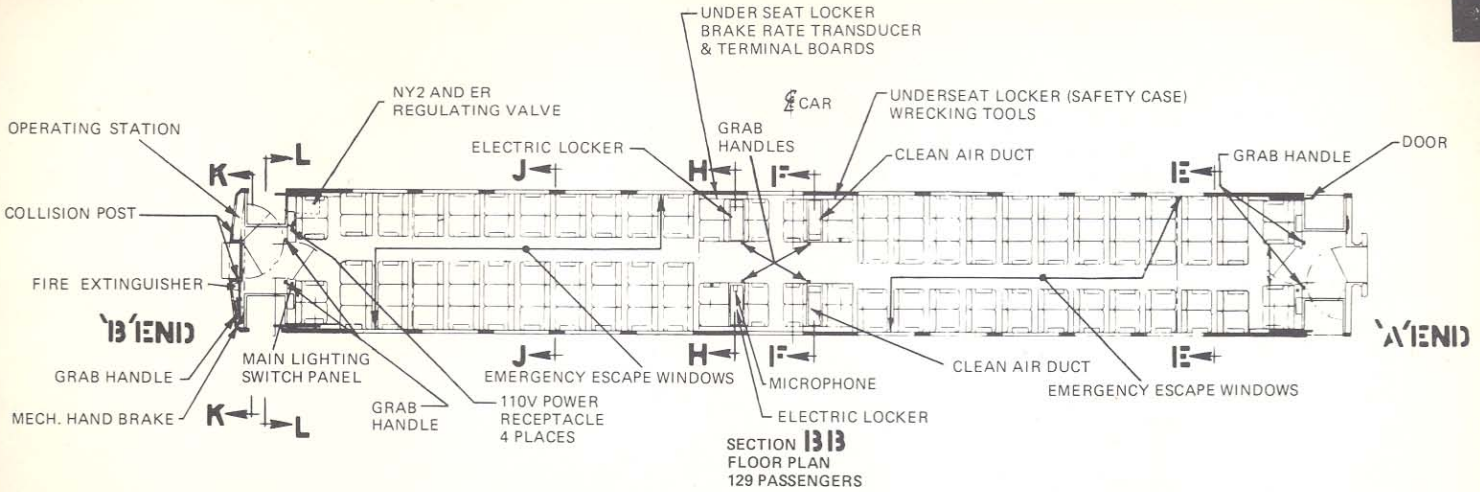


FIG. 1-5. INTERIOR CAR ARRANGEMENT "A" CAR. E-19289

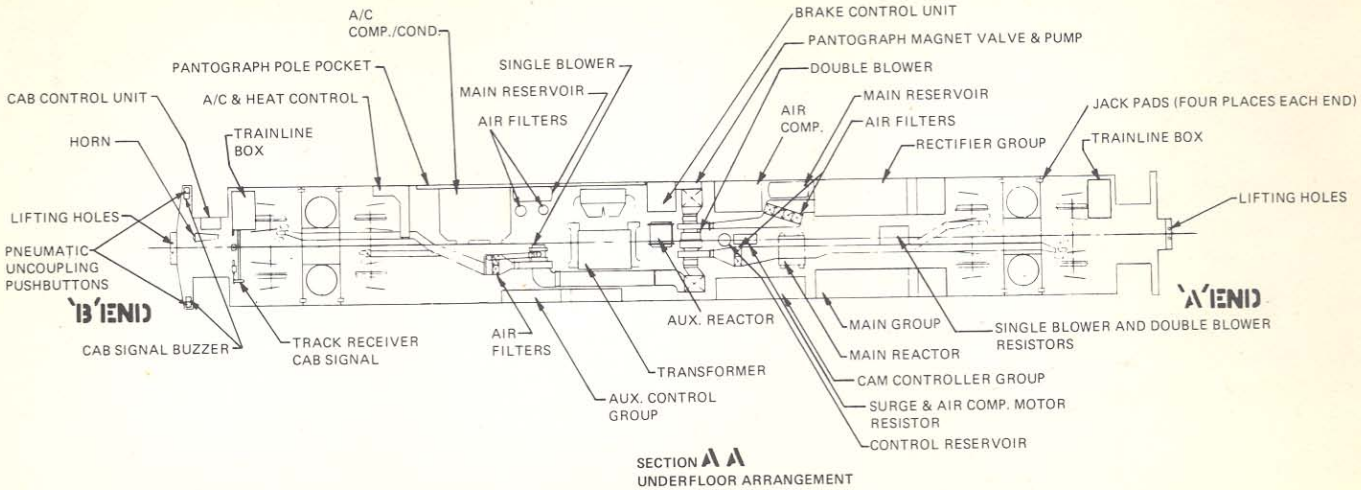


FIG. 1-6. UNDERFLOOR ARRANGEMENT "B" CAR. E-19282

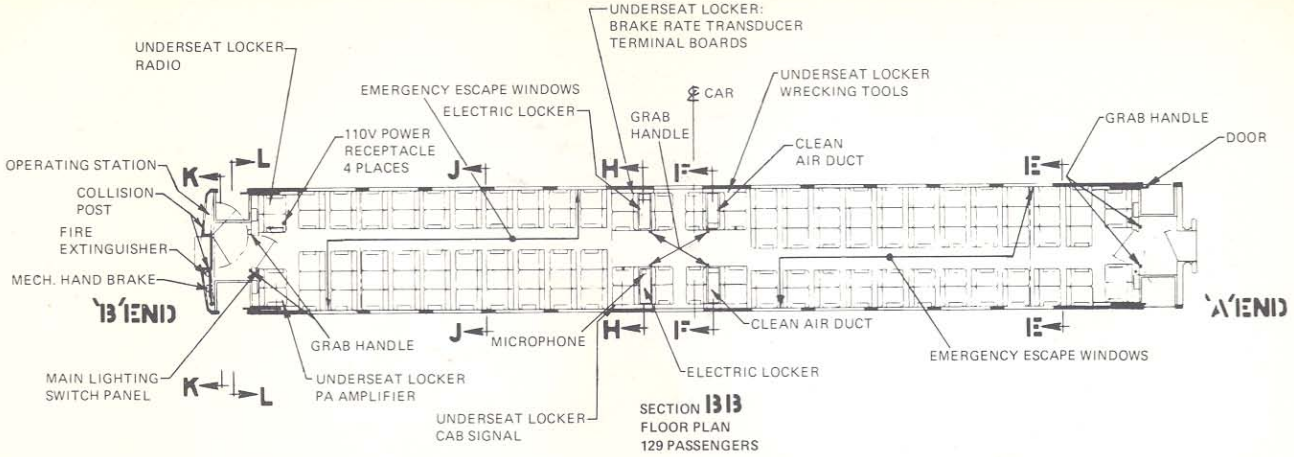


FIG. 1-7. INTERIOR CAR ARRANGEMENT "B" CAR. E-19290

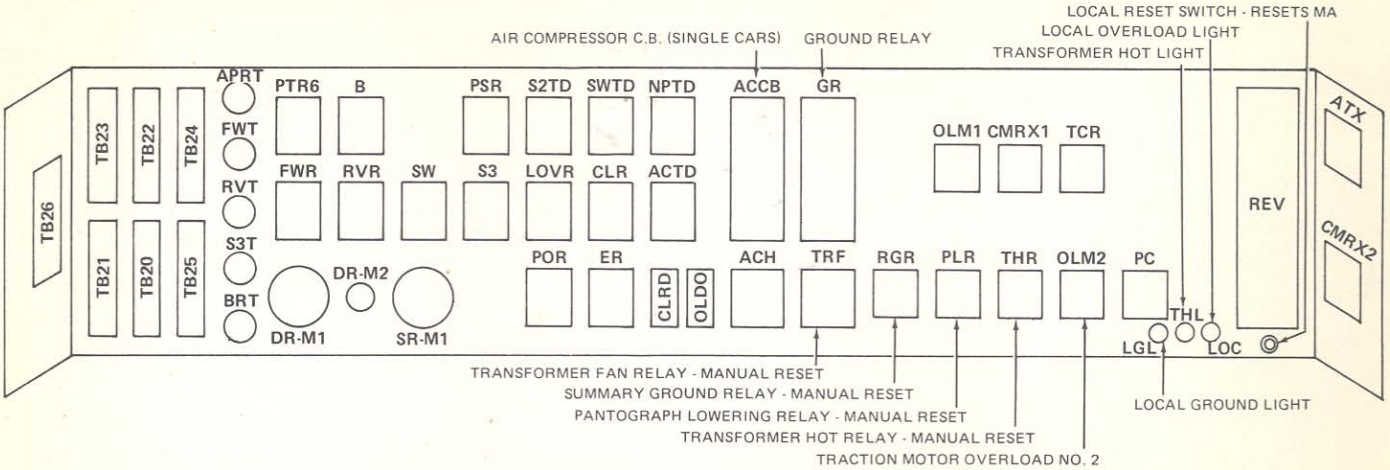
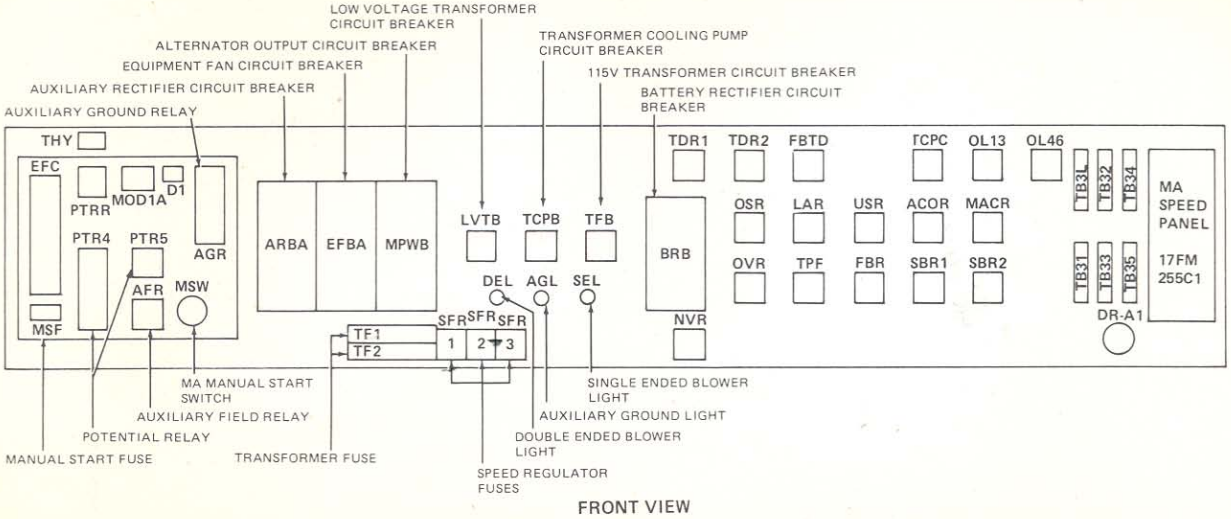


FIG. 1-8. MAIN GROUP, FRONT VIEW, RESETS AND LIGHTS. E-19308



FRONT VIEW

FIG. 1-9. AUXILIARY GROUP, FRONT VIEW, RESETS AND LIGHTS. E-19309

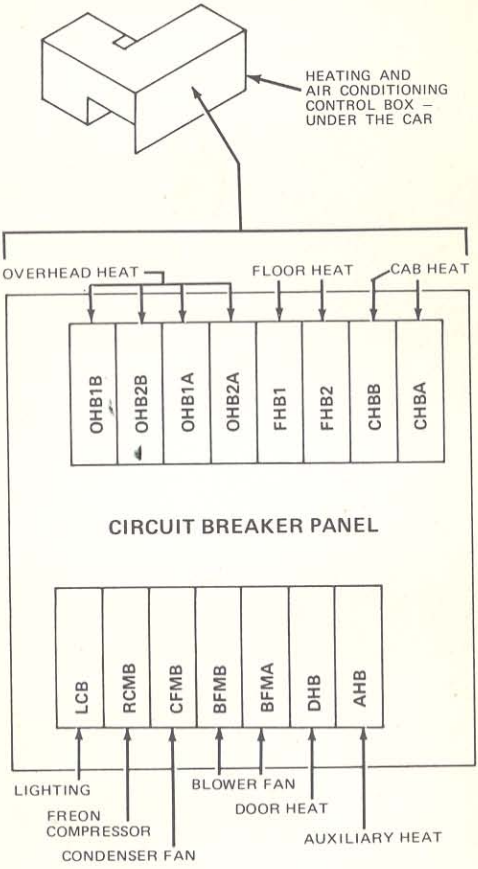


FIG. 1-10. HEATING
AND AIR CONDITIONING
CONTROL BOX BREAKERS. E-19310

II. OPERATING CONTROLS AND INDICATORS

A. ENGINEMAN'S OPERATING STATION

Located at both ends of a single car and at the B (front) end of 'A' and 'B' cars, the engineman's operating station contains all the controls, switches, breakers and indicators required for normal operation of the train.

For the protection of the Engineman, the cab has been fitted with a heavy duty laminated tempered safety glass windshield 9/16" thick.

Overhead vestibule lights controlled by a switch directly over the Engineman's head will provide illumination with a minimum of glare.

The car vestibule end door is equipped to be dogged in the normally closed position. It will swing inward and latch into a position that covers most of the operating controls. The body end door may be locked with a coach key when necessary. The Engineman's seat folds up to allow use of the end side entrance doors for entry and exit.

B. ENGINEMAN'S CONTROLS – SWITCHES AND INDICATORS

1. Control Console (Figure 2-1)

2

a. The Master Controller - is used to operate the train. The master controller handle is spring loaded to the center SAFETY notch which vents the brake pipe and places the train in emergency brake. The master controller handle is moved clockwise to move the train forward, and counterclockwise to move the train in reverse.

To operate the master controller, a CONTROL PLUG must be placed in the CONTROL opening on the front of the controller at the operating station. To move the master controller handle, depress the pushbutton on top of the handle and turn it clockwise or counterclockwise. There are five position (notches) for the handle beside the center notch:

NOTCH		POWER POSITION
1st	-	OFF (Coast)
2nd	-	Switch, transformer winding A, 1/2 voltage
3rd	-	P-1, A winding, full voltage
4th	-	P-2, A & B winding.

NOTCH	POWER POSITION
5th	P-3, A & B & C winding

The pushbutton on the master controller handle must be held down when increasing power or notch position, but need not be held down when reducing power. Release of the handle will allow it to return to the center SAFETY position.

In the event transformer or traction motor overload relays are tripped due to excessive current, (the FAULT LIGHT will be lighted) the relays must be reset. Place the controller handle in the OFF position. Remove the CONTROL PLUG from the CONTROL opening on the front of the controller and place it momentarily in the RESET opening. This will reset the trainlined overload relays.

NOTE: The control plug must be returned to the CONTROL opening within 6 seconds of withdrawal or an emergency brake application occurs on the train.

b. The Automatic Brake Valve - provides service and emergency braking of the train. There are five positions available on the brake valve. These positions are as follows, going counterclockwise from the left:

RELEASE - releases brake cylinder pressure and charges equalizing reservoir and brake pipe to 110 psi.

HOLD - same as Release, except in electro-pneumatic mode holds brake cylinder pressure and Dynamic brake application if speed above 15 mph.

LAP - Holds brake cylinder, brake pipe and equalizing reservoir pressures where they are.

SERVICE - allows brake pipe pressure to reduce and causes brake cylinder pressure to rise. 26 psi brake pipe reduction is maximum service brake and provides 65 psi brake cylinder pressure. Initiates Dynamic braking.

EMERGENCY - vents the brake pipe (to 0 psi) and applies emergency brake. There is no dynamic braking. Brake cylinder pressure is 90-100 psi. Load limiting is in effect.

NOTE: The SERVICE position energizes the dynamic brake trainline. Dynamic and air braking are automatically blended during service braking.

The brake handle may be lifted off the automatic brake valve in the following manner:

Move the handle to the EMERGENCY position and lift up. When it can be moved back to the SERVICE position, do so and lift the handle off.

1) On the left side of the automatic brake valve is the brake valve cutout valve. With the pointer in the down (OUT) position, the automatic brake valve is cut out. With the pointer in the up (IN) position, the automatic brake valve is cut. in. There is a key which must be inserted in the center of the cutout valve and pushed IN in order to move the cutout valve. When the brake cutout valve is OUT, the automatic brake valve is inactive in that cab.

2) On the right side of the automatic brake valve is the brake reset valve. This valve must be depressed and held down to recharge the brake pipe after an emergency brake application or while cutting brake valve IN. While recharging, the valve must be held down until the brake pipe pressure reads at least 80 psi. Normal brake pipe and equalizing reservoir pressure is 110 psi. The brake handle must be in the HOLD or RELEASE position when recharging. The brake valve cutout valve must be in the IN position to allow recharging.

c. Uncoupling Button - operates coupler on that end of the car. It releases the coupler locks on both cars and closes the brake pipe valve in coupler head on the car from which uncoupling is initiated, and allows the standing car to go into emergency brake as the cars are separated. Trainlined control circuits are interrupted at the point of uncoupling. The button must be held down while uncoupling takes place.

d. Horn Button - located at the base of the windshield, it controls the air horn.

2. Floor Mounted Foot Switches (Figure 2-2)

a. Cab Signal Acknowledge switch - on those cars equipped with cab signal, when depressed turns off the cab signal buzzer. The cab signal buzzer is activated when a more restrictive signal aspect is received.

b. Deadman Switch - a spring loaded safety mechanism. Depressing this switch nullifies the SAFETY position of the master controller. The master controller may be released to the SAFETY position without venting the brake pipe as long as the DEADMAN switch is depressed.

c. Door Override Switch - while depressed, allows engineman to remove power from all door opening circuits activated through door control panels. Doors cannot be opened from a door control panel while this switch is depressed.

3. Upper Left Equipment Switch Panel (Figure 2-3)

Name	Function
Cab Heater Switch	Has HIGH, OFF and LOW position to provide high or low constant cab and windshield heat.
Windshield Wiper Control	Operates the variable speed, air operated windshield wiper.

4. Communications Control Unit (Figure 2-4)

Name	Function
Radio/PA Handset	The handset has a press-to-talk switch, depressed when transmitting and released when receiving.

NOTE: Transmission automatically cut off if switch is held depressed for more than 60 seconds.

Name	Function
Radio Light (White)	When lit, indicates communication system is in the RADIO mode, and operative from that control panel.
TNX (Transmit) Light (White)	Lit when transmitting in the radio mode.
PA Push button/light (White)	When handset is OFF the cradle, pushing button momentarily, connects handset microphone to PA speakers and lights PA light. Replacing handset in cradle disconnects PA mode.
Frequency Switch	May be set to one of four predetermined channels.
Volume Control	Varies the volume of the monitor speaker.
Monitor Speaker	Allows engineman to hear all radio transmissions on channel selected whether handset is on or off the cradle. Operates whenever Radio or PA light is lit.

5. Lower Left Equipment Indicator Light and Switch Panel (Figure 2-5)

Name	Function
Brake Applied Light* (Amber)	Will light indicating all brake cylinders on train have at least 30 psi pressure; will go out when any brake cylinder has dropped below 15 psi.
Brake Release Light* (Green)	Will light indicating all brake cylinders on train have less than 15 psi pressure; will go out when any brake cylinder has at least 30 psi pressure.
Fault Light (White)	Lights when ground relay trips out, if a propulsion system or traction motor overload occurs, if a transformer overload, overheat, or fan failure occurs, if an A contactor overload occurs, or if a local NO POWER light is lit.
Train Stop Light* (Red) (Penn Central only)	When lit, indicates cab signal buzzer calling for lower speed has not been acknowledged within 6 seconds after receiving a more restrictive signal aspect and train emergency brake application has occurred.

*These lights are active only in cab with control plug in master controller.

Name	Function
Door Closed Light (Clear)	When lit, indicates all side end doors are closed. If light is out, train will not take power. Light goes out when any door is opened. Doors opened with low level trap raised bypass door closed light circuit. This light active in all cabs.
Handbrake Applied Light (Blue)	Lights when any handbrake is applied. Goes out when all handbrakes are OFF. When lighted, is lit in operating cab and in cab (or cabs) of car in which handbrake is applied.
Dynamic Brake Out Light (Red)	When lit, indicates dynamic brake out on some car in train. Light will also be lit in cab (or cabs) of car in which dynamic brake is out. **NOTE:** Lit only while service braking is being called for.
Headlight Switch	Has three positions, BRIGHT, DIM and OFF to control the headlights, car number signs and gauge lights.

NOTE: All indicator lights have PRESS-TO-TEST feature.

6. Left Vertical Switch Panel (Figure 2-6)

Name	Function
End Door Control Bypass Switch*	When ON, provides emergency bypass for the trainlined interlocks which remove propulsion control when any door is open. Operate only in accordance with Railroad operating instructions.
Trainline Dynamic Brake* Cutout Switch	Cuts out dynamic brake on all cars in the train. Automatic air braking only will be available. **NOTE 1:** Dynamic Brake out light does not come on. **NOTE 2:** If EPCS switch in the operating cab is in the cutout position, dynamic brakes cannot be cutout on a trainline basis.
Snow Brake Switch*	Allows application of 8 to 11 psi in all brake cylinders to keep shoes in light contact with wheels, thereby preventing ice and snow deposits which would interfere with normal brake action.

*Active only in operating cab.

Name	Function
Buzzer Cutout Switch	Cuts out the signalling buzzer in that cab of the train.
Pantograph Rise* (push button)	Releases pantograph latches throughout the train to allow pantographs to rise.
	NOTE: Pantograph LOWER switch must be in the OFF position or pantographs will be held down by air pressure. Control plug must be in the control receptacle.
Pantograph Lower Switch	Lowers all pantographs on the train.

7. Top Center Switch Panel (Figure 2-7)

Name	Function
Microswitch, left side of panel	Cuts out cab heater and defroster when vestibule end door is swung inward and latched over the cab controls.

*Active only in operating cab.

Name	Function
Electro Pneumatic Cutout Switch	Cuts out electro-pneumatic mode in automatic brake system. The EP mode allows quicker application response and more graduated steps during brake applications and releases. It also holds brake cylinder pressure with the brake valve in the HOLD position.

NOTE: If EPCS switch in the operating cab is in the cutout position, dynamic brakes cannot be cutout on a trainline basis.

8. Upper Right Cab Signal Indicator Panel (Figure 2-8)

Name	Function
Cab Signal Indicator Panel	Indicates cab signal aspects when in cab signal territory.

Restricting aspect is	
Approach aspect is	
Approach medium aspect is	
Clear aspect is	

9. Lower Right Gauge Panel (Figure 2-9)

Name	Function
Brake Pressure Gauge	Red pointer indicates brake cylinder pressure on that car; white pointer indicates trainlined brake pipe pressure.
Brake Reservoir Pressure Gauge	Red pointer indicates main reservoir pressure on that car; white pointer indicates equalizing reservoir pressure on that car.
Speed Indicator	Indicates actual speed of train (0-120 MPH)
Load Indicator	Indicates performance of the traction motor system on that car. The pointer is in the horizontal position with no load. A downward deflection indicates propulsion, while an upward deflection indicates dynamic braking.

10. Miscellaneous Switches and Fittings

Name	Function
Air Gauge Test Fittings	Test fittings to calibrate air brake gauge readings for: Brake Cylinder Brake Pipe Main Reservoir Equalizing Reservoir
Single Car Emergency Stop Valve	Activates an emergency stop unit on that car placing that car in emergency braking. Brake cutout valve must be IN at that cab for this valve to be activated. The emergency stop valve is meant for use in single car operation only. It activates emergency brake in one car only.
Horn cutout cock	Cuts out air line to horn button. When cut out horn cannot be sounded.

11. Overhead - Ceiling Switch Panel (Figure 2-10)

Name	Function
Clearance Lights Switch	Operates the clearance lights for low level boarding at that end of the car.
Marker Lights Switch	Operates the marker lights at that end of the car.
Vestibule Lights Switch	Operates the vestibule ceiling lights in that end of the car.

C. CONDUCTOR'S CONTROLS, SWITCHES AND INDICATORS

1. Door Control Panel (Figure 2-11)

Name	Function
Door Key Switch (ON-OFF)	Operated by coach key to activate the door control panel and its trainline functions; key must be inserted while opening or closing doors but can be removed while doors are opened or closed.

Name	Function
Open Push Button Switches (Red)	Pressing center button opens the door at which the conductor is standing. Pressing a side button opens all doors ahead of or to the rear of the conductor as indicated by the arrows.
Close Push Button Switches (Green)	Closes door in respective zones or that door only whether doors were opened by control panel or crew key.

2. Main Light Switch Panel (Figure 2-12)

Name	Function
Main Lights 1, 2 & 3	Operate the three main interior light circuits. Turning any of the three switches ON activates the emergency light circuit which goes on in case MA output drops below 160V.

NOTE: On Reading cars, main light circuit No. 3 is 38 VDC and will also remain on if MA output drops below 160V.

D. CIRCUIT BREAKERS AND OTHER SWITCHES

1. Vestibule

a. Circuit Breaker Panel B End (Behind Engineman) (Figure 2-13)

Name	Function
Air Compressor Control Circuit Breaker (single and B cars)	Activates and protects the air compressor and air compressor control circuits. 38 VDC
Headlights Circuit Breaker	Controls and protects the 38 VDC circuit that provides power to the headlights.
Vestibule and Clearance Lights Circuit Breaker	Controls and protects the 38 VDC circuits that provide power to the vestibule and clearance lights.
Gauge and Number Signs Circuit Breaker	Controls and protects the 38 VDC circuits that provide power to the gauge and number sign lights.
Marker Lights Circuit Breaker	Controls and protects the 38 VDC circuit that provides power to the marker lights.

Name	Function
Emergency Lights Circuit Breaker	Controls and protects the 38 VDC circuit that provides power to the incandescent lights in the emergency light circuit.
Main Lighting Circuit No. 3 Circuit Breaker	Controls and protects the 230 VAC (38 VDC on Reading cars) No. 3 main fluorescent lighting circuit.
Main Lighting Circuit No. 2 and No. 1 Circuit Breakers	Controls and protects the 230 VAC No. 1 and No. 2 main fluorescent lighting circuits.
Defroster Circuit Breaker	Controls and protects the 115 VAC circuit that provides power to the defroster blower motor.
Convenience Outlet Circuit Breaker	Controls and protects the 115 VAC receptacles throughout the car.
Automatic Changeover Circuit Breaker (Reading Cars)	Controls and protects the 38 VDC automatic changeover control circuit.

Name	Function
Communications Circuit Breaker (Single and B cars)	Controls and protects the 38 VDC communications circuits, both radio and PA.
Auxiliary Control Circuit Breaker (Single and A cars)	Controls and protects the 38 VDC MA, blower, and transformer pump control circuits.
Heat and Air Conditioning Circuit Breaker	Controls and protects the 38 VDC heating and air conditioning control circuits.
Traction Control Circuit Breaker	Controls and protects the 38 VDC power to the traction control logic and electronic circuits.
Protective Heat Circuit Breaker	Controls and protects the 38 VDC power to the protective heating control circuit.
Door Motor Circuit Breaker	Controls and protects the 38 VDC power to the door motor circuits.

Name	Function
Door Control Circuit Breaker	Controls and protects the 38 VDC power to the door control circuit.
Trainline Control and Fault Protection Circuit Breaker	Controls and protects the 38 VDC power to the trainline control and fault protection circuits.
DC-DC Converter Circuit Breaker (Penn Central Single and B cars)	Controls and protects the 38 VDC circuit that provides power to the 32 VDC regulator
Cab Signal Circuit Breaker (Penn Central Single and B cars)	Controls and protects the 32 VDC regulated power to the cab signal and ATS systems.

b. Trainline (and Switch) Panel, B End (opposite cab) (Figure 2-14)

Name	Function
Local Pant Down Switch (Single and B Cars)	In TRAINLINE position, permits trainlining of pantograph control so that all signals come from the operating cab. In DOWN position lowers pantograph on that car and nullifies cab pantograph switches.

Name	Function
Overhead Heat Cutout Switch	When OFF, cuts out both stages of overhead heating.
Floor Heat Cutout Switch	When OFF, cuts out both stages of floor heat
Door trainline Cutoff Switch	Interrupts door control circuits so that doors in all cars from that point beyond will not respond to trainlined door opening or closing commands.
NPRS (No Power Reset Switch) (bottom of trainline panel)	Resets the no power relay to extinguish local no power lights on exterior of that car and trainlined FAULT lights in all cabs.

c. Trainline Panel, A End (Figure 2-15)

Name	Function
Door Trainline Cutoff Switch	Interrupts door control circuits so that doors in all cars from that point beyond will not respond to trainlined door opening or closing commands.

2. Electric Lockers (Center of Car)

a. No. 1 Electric Locker (Right Side) (Figure 2-16)

This locker contains the Performance and Fault Indication display Unit. This unit monitors motoring current and performance. It indicates and holds faults in the propulsion and power collection circuits. Car troubleshooting is aided substantially by the indications shown on this panel.

Name	Function
Power ON-OFF Switch	This switch activates the P and F1 panel.
Press-To-Test Button	Pressing this button lights all the lights on the panel to see that they work properly.
Reset Button	Resets the P and FI display unit. Panel is then ready to monitor the system for any possible new faults.

b. No. 2 Electric Locker (Left side) (Figure 2-17)

Name	Function
No Motion Reset Push Button	Resets the no motion panel.
Emerg. Air Compressor Start Switch (Penn Central B Car Only)	In case of blower motor failure which will shut down air compressor motor, HOLD IN to run air compressor to build up main air reservoir pressure to 130-140 psi so that married pair may be run. Releasing switch shuts off the air compressor.
Brake/Motor Cutout switch	
DYN	Cuts out dynamic brake on that car. Lights the Dynamic BRAKE OUT light whenever brakes are applied.
NORM	Car operates normally. Nothing is cut out.
MOTOR 1-2	Cuts out propulsion on axles 1 and 2. Cuts out dynamic brake on that car. DYNAMIC BRAKE OUT light lights whenever brakes are applied. After 25 seconds in a power position, NO POWER light on car comes on, FAULT light in cab comes on.

Name	Function
	NOTE: Car is automatically limited to minimum acceleration.
MOTOR 3-4	Cuts out propulsion on axles 3 and 4. Other actions are as MOTOR 1-2.
ALL MOTORS	Cuts out propulsion and dynamic brake on that car. Other actions are as in MOTOR 1-2.
Battery Trainline Circuit Breaker	Disconnects the car battery charger and the loads from the trainline, 38 VDC.
Battery Circuit Breaker	Disconnects the car battery charger and the loads from the battery.
Train Stop Cutout Switch (Penn Central Only)	Cuts out the automatic train stop feature of the cab signal equipment. This allows normal train operation in the event of equipment trouble.

c. Lower Panel (Reading Cars Only) (Figure 2-18)

Name	Function
Manual Changeover Switch	
OFF	Off
OFF	Off
11K	Activates the 11,000 volt changeover signal.
25K	Activates the 25,000 volt changeover signal.
VIOL Light	Lights when vacuum interrupter is open.
TCHL Light	Tap changer high light lights when tap changer is in the 25K position.
TCLL Light	Tap changer low light lights when tap changer is in the 11K position.

3. Auxiliary (Underfloor) (Figure 1-9)

The auxiliary control group box on the left side of each car near the B end, contains the following breakers, switches and fuses for auxiliary equipment. These are located on all single cars and on A cars unless otherwise noted.

a. Auxiliary rectifier breaker (ARBA)
b. Equipment clean air fan breaker (EFBA)
c. Alternator output breaker (MPWB)
d. Low voltage transformer breaker (LVTB)
e. Transformer coolant pump breaker (TCPB)
f. 115 volt transformer breaker (TFB)
g. Battery rectifier breaker (BRB)
h. Auxiliary ground reset switch (AGR)
i. Motor alternator manual start switch (MSW)
j. Speed regulator fuses SRF 1-4
k. Air compressor circuit breaker (B-car) (ACCB, Main Group)
l. Manual start fuse MSF

4. Heating and Air conditioning (Underfloor)

The heating and air conditioning control box, right side of each car, near B end contains the breakers for the floor heat, overhead heat and cab heat as well the breakers for the exhaust fan, evaporator and condensor fans, compressor motor and drain and protective heaters.

Drain heaters are provided for the air compressor and main reservoir automatic drain valves. These operate on 115 VAC and are controlled by a 40° F thermostat in the temperature control panel box.

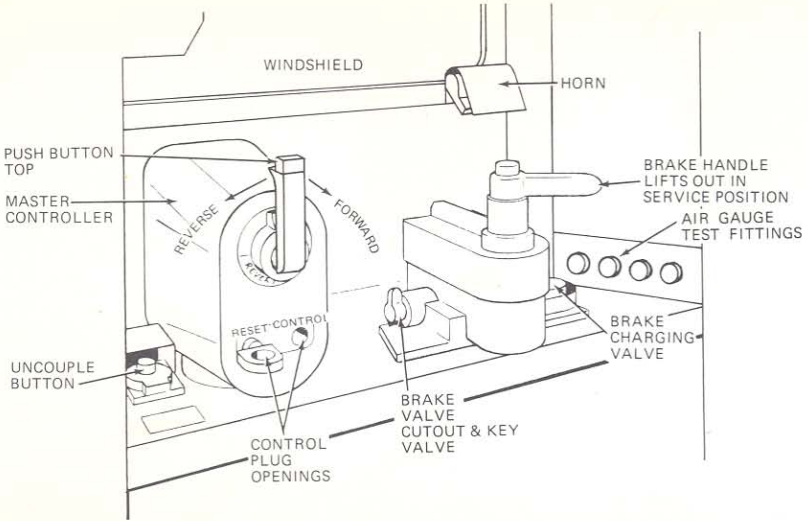


FIG. 2-1. CONTROL CONSOLE. E-19311

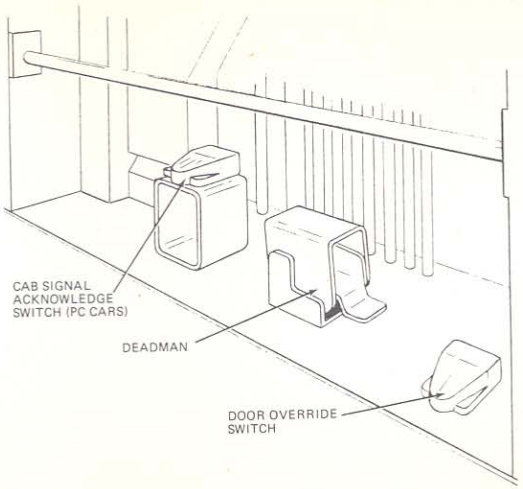


FIG. 2-2. FOOT SWITCHES. E-19312

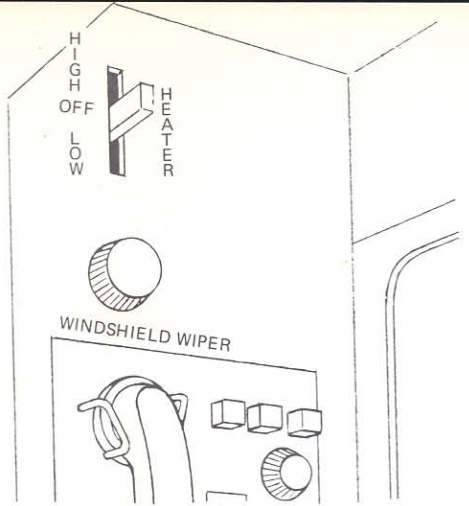
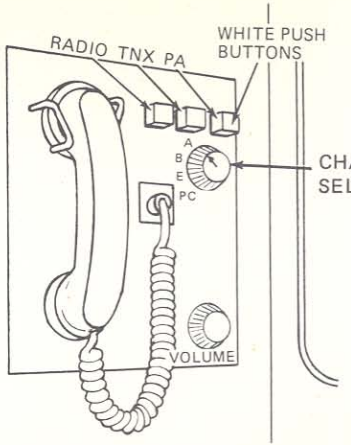


FIG. 2-3. UPPER LEFT EQUIPMENT SWITCH PANEL. E-19319



OPERATING CHANNELS

RAILROAD	FUNCTION	CHANNEL
READING	ROAD	A
READING	YARD	B
READING	FOREIGN	E
P.C.	-----	PC

FIG. 2-4. COMMUNICATIONS CONTROL UNIT. E-19320

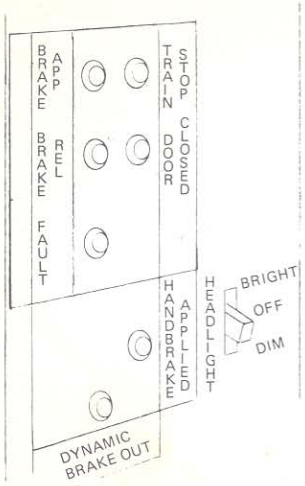


FIG. 2-5. LOWER LEFT EQUIPMENT INDICATOR LIGHT AND SWITCH PANEL. E-19231

*ACTIVE ONLY IN OPERATING CAB

FIG. 2-6. LEFT VERTICAL SWITCH PANEL. E-19324

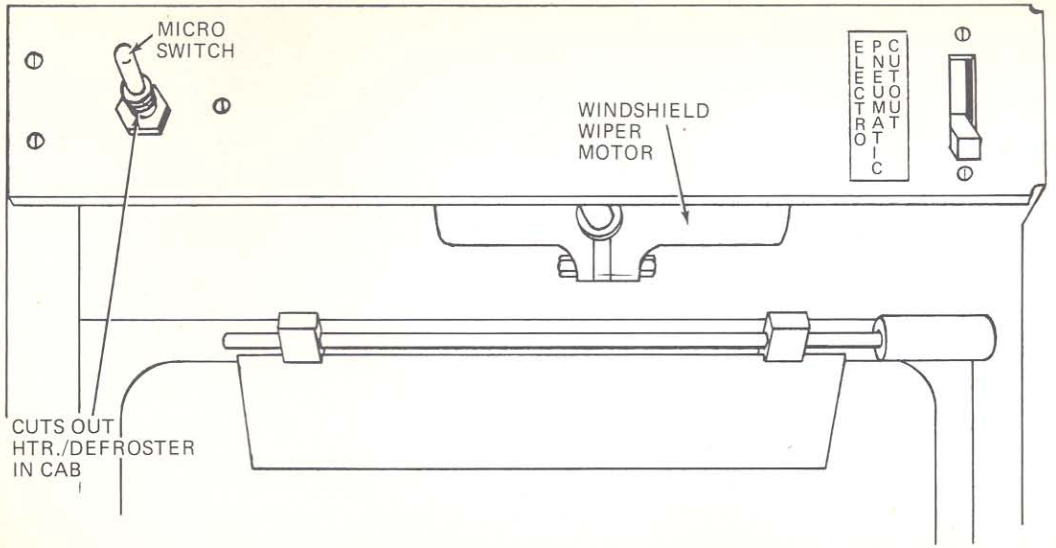


FIG. 2-7. TOP CENTER SWITCH PANEL. E-19323

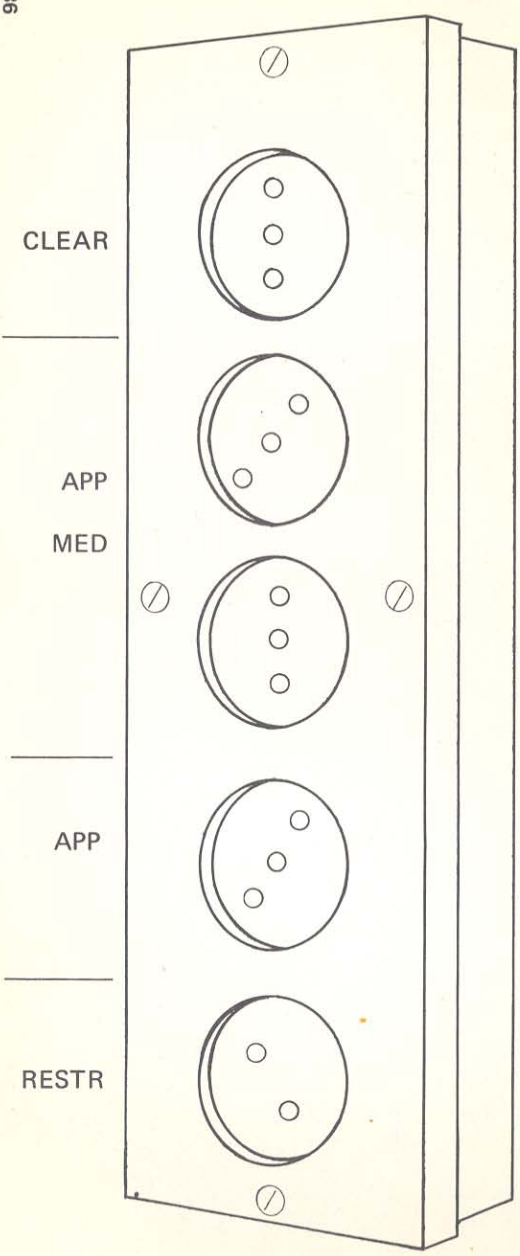


FIG. 2-8. UPPER RIGHT CAB SIGNAL INDICATOR PANEL. E-19325

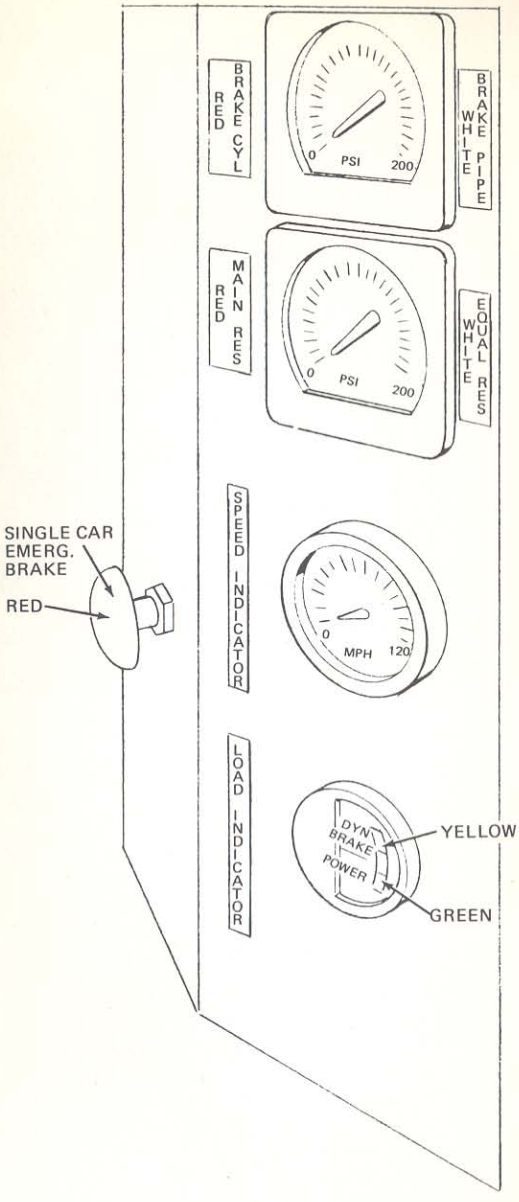


FIG. 2-9. LOWER RIGHT GAUGE PANEL. E-19326

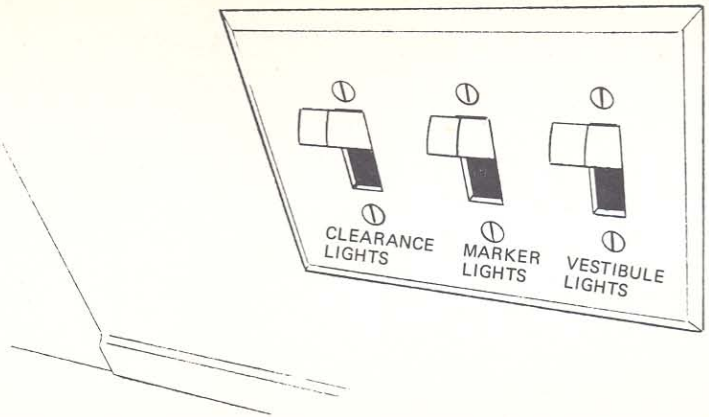


FIG. 2-10. OVERHEAD-CEILING SWITCH PANEL. E-19322

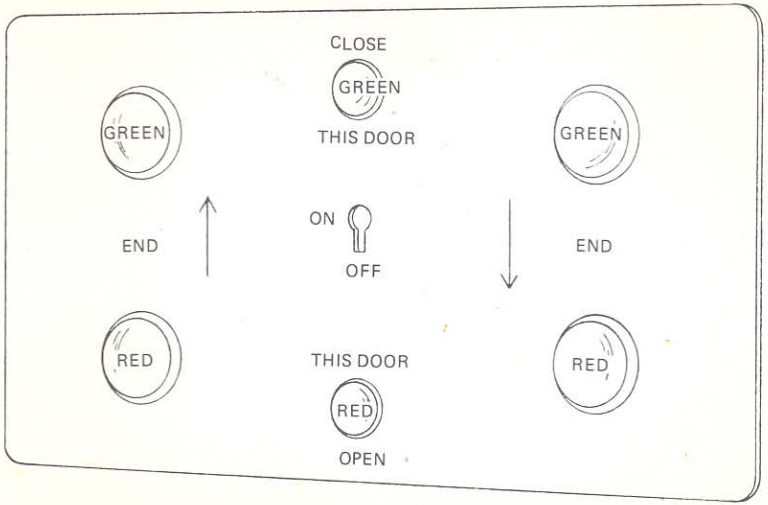


FIG. 2-11. DOOR CONTROL PANEL (A AND B END VESTIBULES).
E-19313

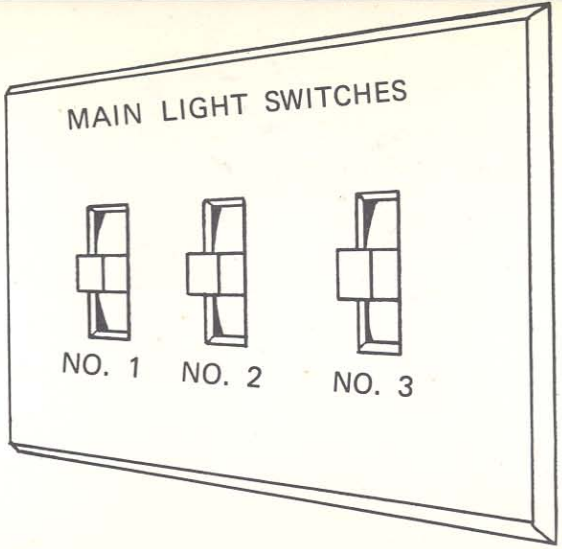


FIG. 2-12. MAIN LIGHT SWITCH PANEL - B END (INTERIOR BODY END, LEFT SIDE). E-19314

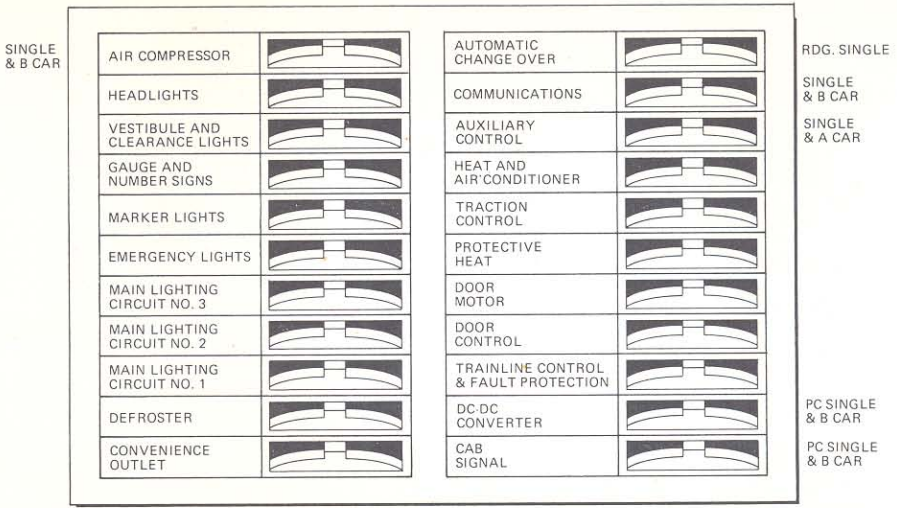


FIG. 2-13. CKT BREAKER PANEL - B END (BEHIND ENGINEMAN). E-19315

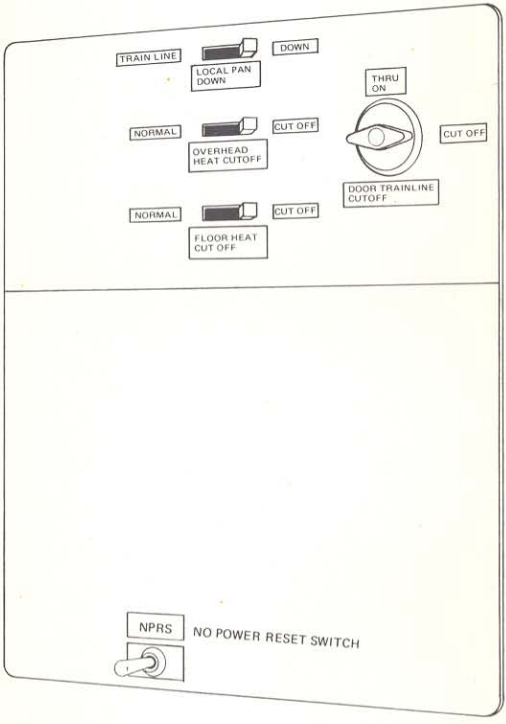


FIG. 2-14. TRAINLINE & SWITCH PANEL - B END (OPPOSITE CAB). E-19316

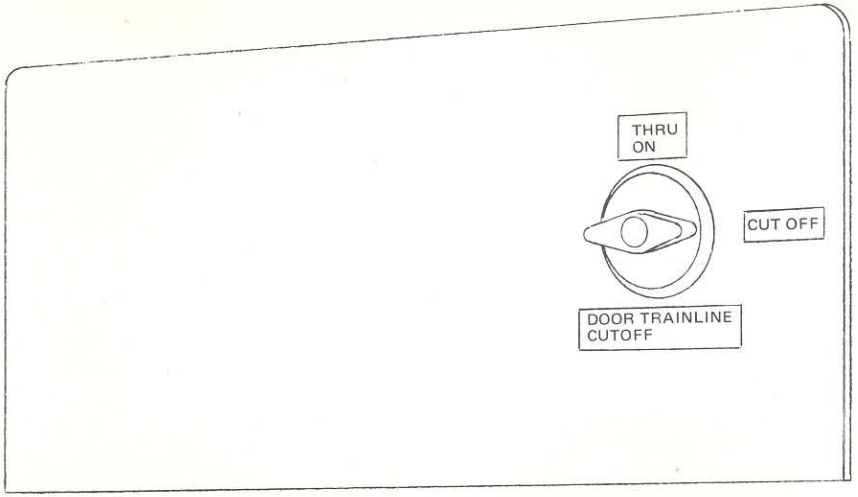


FIG. 2-15. TRAINLINE PANEL - A END. E-19317

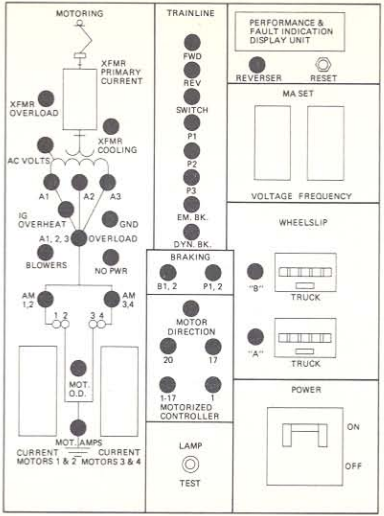


FIG. 2-16. NO. 1 ELECTRIC LOCKER. E-19328

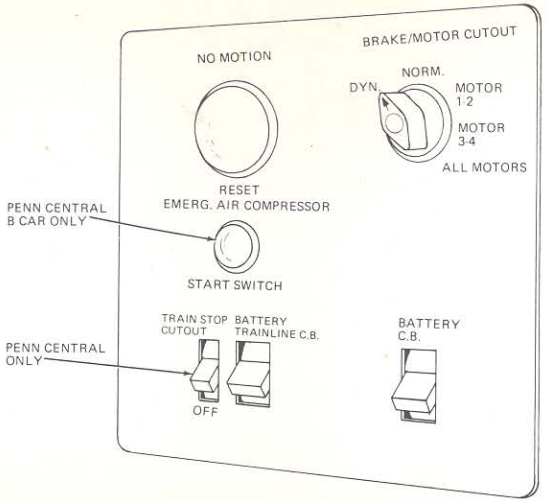


FIG. 2-17. NO. 2 ELECTRIC LOCKER, UPPER PANEL. E-19318

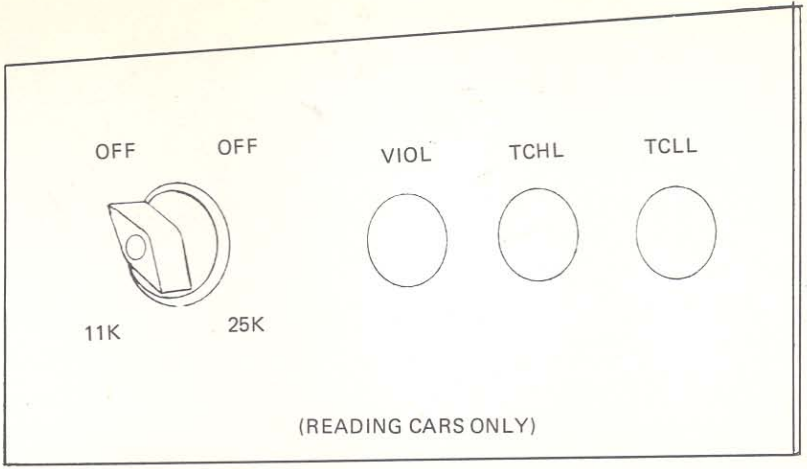


FIG. 2-18. NO. 2 ELECTRIC LOCKER, LOWER PANEL (READING CARS ONLY).
E-19327

III. CAR OR TRAIN OPERATION

A. PREPARING A TRAIN FOR SERVICE

1. Inspection

To prepare a train for service and enter a car when the battery circuits are energized, a side entrance door may be opened for access using the key switches.

NOTE: The cab side entrance door on single cars and married pairs and the non cab side at the A end of married pairs can be operated using the crew key switch located adjacent to that door.

a. Turn the snap cover on the external switch and insert a coach key. Open the door by turning the key to OPEN momentarily then remove the key.

b. Close the door from the inside using the door control panel next to the door by inserting the key and pressing the CLOSE THIS DOOR button.

c. In each car, turn on all circuit breakers in the B end circuit breaker panel.

d. In each trainline switch panel make sure the LOCAL PANT DOWN switch is in the TRAINLINE position. Check to see that the OVERHEAD HEAT CUTOUT and FLOOR HEAT CUTOUT switches are in the NORMAL position. Make sure the DOOR TRAINLINE CUTOFF switch is set to THRU or CUTOFF as required.

e. In each cab other than operating station, make sure all switches on the cab left vertical switch panel are in the OFF position.

f. Turn on the marker lights (rear car only) necessary clearance lights and vestibule lights.

g. Turn on the car interior light switches 1, 2 and 3 on the interior of the body end bulkhead.

NOTE: This also activates the emergency light circuits.

h. In the No. 2 electric locker press the NO MOTION RESET button, see that the BRAKE/MOTOR CUTOUT switch is in the NORMAL position, ensure that the BATTERY and BATTERY TRAINLINE circuit breakers are ON. Check to see that the MANUAL CHANGE-OVER switch is in the OFF position.

i. Insure sufficient hand brakes are applied to secure the train.

After checking the foregoing items throughout the train, descend to the road bed and inspect the following along the train:

a. Locomotive haul air hose clamped securely and angle cock closed.

b. End car electric coupler doors fully closed.

c. Red indicator pins on all couplers flush with or slightly recessed within the side of the coupler.

d. Coupler adapters tightly fastened in place.

e. Brake pipe cutout cocks open (both ends of each car).

f. Main reservoir cutout cocks open (both ends of each car.)

g. Truck cutout cocks (BC cock) open (2 per car, handle down).

h. Air spring cocks open (2 per truck, handle down).

i. Brake shoe wear above condeming limits.

j. Control unit cutout cock in IN position (handle down).

k. Check auxiliary control group. All circuit breakers should be ON, no overload or tripped relays present.

l. Check main control group. Reset any tripped relays or overloads.

m. Check the heat exchangers on the following equipment for paper, leaves and other obstructions to the flow of air: main transformer, air conditioner, air compressor (single and B cars).

Pantographs should be raised using the following procedures:

a. Check all LOCAL PANT DOWN switches, in the B end trainline and switch panels, to see they are in the TRAINLINE position.

b. Check all PANTOGRAPH LOWER switches, on the cab left vertical panel, to see they are OFF.

c. Operate the pantograph pump on each single or B car of a pair to release the pantograph.

d. Pantograph will rise and engage the trolley wire.

e. When all pantographs are raised, check all MA sets and air compressors to make sure they are running.

Engineman will board the train and proceed to the operating cab.

a. Place the control plug momentarily in the RESET opening on the master controller to insure that the trainlined transformer and traction motor overload relays are reset.

b. Place a control plug in the CONTROL opening to activate that cab in the train.

c. Check all switches and circuit breakers in the cab to see they are properly positioned.

d. Charge the brake pipe by performing the following steps.

1) Move master controller to OFF or depress DEADMAN foot switch.

2) Put on brake valve handle. Place in RELEASE or HOLD.

3) Turn brake valve cutout valve up to the IN position.

4) Depress the brake reset valve and hold until brake pipe pressures reaches at least 80 psi. Brake pipe pressures should rise to 110 psi.

2. An initial brake test should be made by performing the following steps:

a. After the air brake system is fully charged, and upon receipt of a signal to apply the brakes, a 20 pound brake pipe reduction must be made in the automatic brake operation. With the brake valve handle in the LAP position, the brake valve cut-out valve must be placed to the OUT position, after which the number of pounds of brake pipe leakage per minute is noted, as indicated by the brake pipe gauge. Brake pipe leakage must not exceed 5 pounds per minute. Then, while holding the brake reset valve depressed to prevent an emergency application, the brake valve cut-out valve must be placed to the IN position, then the reset valve released.

b. Brake pipe reduction must now be increased to 26 pounds (a Full Service application), after which an inspection of the train brakes must be made to determine that the brakes are applied on each car; that the brake rigging does not bind or foul; and that all parts are properly secured. When this inspection has been completed, the RELEASE signal must be given and brakes released, after which another inspection must be made to verify all brakes on the train have released.

3

c. The EPCS switch must now be closed, and after receiving a signal to apply brakes for a test, a 20 pound electro-pneumatic brake application must be made, as indicated by the brake cylinder gauge. Inspection of the train brakes must then be made to determine if brakes are applied on each car. When this inspection has been completed, the RELEASE signal must be given and brakes released, after which another inspection must be made to verify all brakes on the train have been released.

d. For single car operation the following additional test must be made:

The single car emergency stop valve (Red button) must be depressed. This will give 100 psi brake cylinder pressure. Inspect brakes to determine that they are applied, after which a release signal must be given and the emergency brake valve must be pulled out (OFF). Inspect the brakes again noting that they are released.

NOTE: The amber BRAKE APPLIED light will go out when any brake cylinder pressure on the train has dropped below 15 psi. The green BRAKE RELEASE light will light when all brake cylinders on the train have dropped below 15 psi. The BRAKE RELEASE light will go out when any brake cylinder on the train has at least 30 psi pressure. The BRAKE APPLIED light will light when all brake cylinders on the train have at least 30 psi pressure.

B. OPERATING PROCEDURES

1. Starting a car or train.

After the cars have been properly inspected, tested, and released for operation:

a. Insert control plug in control opening.

b. Place controller in OFF position.

c. Place brake valve handle in RELEASE or HOLD.

d. Charge brake pipe to 110 psi.

e. Check to see that clear DOOR CLOSED light is lit.

f. Release all handbrakes on the train. Blue HANDBRAKE APPLIED light should be out.

g. Place brake valve handle in RELEASE. Check that green BRAKE RELEASED light is lighted.

h. Move master controller handle to desired power position to move forward or backward. Power positions are, SWITCH, P-1, P-2 and P-3.

NOTE: If the master controller handle is advanced to a power position while the Engineman's door closed light is off, the train will not start when the light comes on. The controller must be in OFF when the light comes on, or must be returned to the OFF position and again advanced to a power position before the train will start.

Brake release light will light green when all brake cylinders on train have less than 15 psi.

Master controller handle must be held at desired power position during operation. Release of the handle will allow it to return to SAFETY and cause emergency brake application, unless deadman foot switch is depressed.

2. Coasting

Moving the master controller to the OFF position will permit the train to coast. Brake valve handle should normally be in RELEASE.

3. Stopping

The automatic air brake is capable of graduated service application or release under control of the engineman by movement of the brake valve handle.

a. Master controller should be placed in the OFF position.

b. To slow or stop, move the brake valve handle to the SERVICE position until the desired reduction of brake pipe pressure is reached.

c. Move the brake handle to LAP or HOLD.

NOTE: Traction power will be cut off with a reduction of brake pipe pressure to 103 psi or lower or with BCP of 30 psi or greater regardless of master controller position.

d. Manipulate the brake valve handle for braking as required. Amber BRAKE APPLIED light will come on when dynamic braking fades and BCP on all brake cylinders is at least 30 psi.

Emergency brake may be applied by any of the following procedures:

a. Move brake valve handle to EMERGENCY.

b. Release deadman foot switch and master controller to the center SAFETY position.

c. Pull conductor's emergency valve.

d. When cab signal is in use (Penn Central cars), an emergency brake application will be made if the engineman fails to acknowledge a more restrictive aspect within 6 seconds, or if the acknowledge button is held longer than 6 seconds.

NOTE: After an emergency brake application, there is a 45 second time delay before the brake pipe can be recharged.

Single cars are equipped with an additional and separate emergency brake system, the SINGLE CAR EMERGENCY. Single car emergency is initiated by pressing a red button in the operating cab or whenever main reservoir pressure drops below 67 psi. Single car emergency brake application can only be made on an individual single car with an operating cab. In order to release the brakes following an application, main reservoir pressure must be above 67 psi and the single car emergency brake valve (red button) must be closed (pulled out).

NOTE: During all emergency brake applications, propulsion and dynamic brakes are locked out. Wheel slip/slide protection is nullified during deadman and single car emergency brake application.

4. Reversing Direction

From a stop:

a. Depress deadman foot switch if BCP is less than 60 psi.

b. Move master controller counterclockwise to a power position.

c. Release brakes. Train will move in reverse.

From forward movement:

a. Move master controller to OFF.

b. Make a service brake application of at least 30 psi. Stop the train.

c. Depress deadman foot switch (if BCP is less than 60 psi).

d. Move master controller counterclockwise to reverse OFF or power position.

e. Release brakes. Train will move in reverse.

CAUTION: When reversing the train, make at least a 12 pound brake pipe reduction. Brake cylinder pressure must be 30 psi or more to throw the reverser. If stop is made with less than 30 psi BCP, train will take power in the reverse direction.

5. Cab Signal Operation (Penn Central Only)

The indicators on the cab signal panel clearly present the signal aspects when in cab signal territory. To operate in cab signal territory, make sure the cab is properly set up.

a. Check the B end circuit breaker panel to see that the DC-DC CONVERTER and CAB SIGNAL circuit breakers are ON.

b. See that the TRAIN STOP cutout switch in the No. 2 electric locker is OFF.

c. After placing a control plug in the control opening in the master controller, step momentarily on the ACKNOWLEDGE foot switch. This will pick up relays which permit charging of the brakes.

d. When stopped awaiting a code to move, the cab signal buzzer will sound to show a speed code. Acknowledge before starting.

e. Once started, observe the signal aspects on the cab signal panel.

f. The cab signal buzzer will sound an alarm on a more restrictive change in cab signals.

NOTE: When there is an upward change in cab signal indication to denote a less restrictive speed, no buzzer warning is sounded and acknowledgement is not required.

NOTE: If alarm is not acknowledged within 6 seconds, a penalty (emergency) brake application will automatically take place.

If a penalty brake application occurs the train will be brought to a complete stop as in any emergency brake application, except that wheel slip/slide system is still in effect. It will be necessary to wait 45 seconds before recharging the brake pipe and proceeding.

NOTE: The automatic train stop feature of the cab signal may be cut out by placing the TRAIN STOP CUTOUT switch, in the No. 2 electric locker, to the CUTOUT position. The cab signal lights will continue to operate and the cab signal buzzer should be acknowledged.

6. AC Power Changeover, 11-25KV (Reading Company Only)

Changeover from 11,000V to 25,000 V catenary power takes place automatically. Wayside equipment at the changeover point activates the vacuum interrupter and transformer tap changer through track receivers under the car. The changeover will be made automatically in either direction, 11,000 V to 25,000V, or 25,000V to 11,000V.

In the event a car in a train does not complete the changeover automatically, the vacuum interrupter will remain open and there will be no power to the car. All propulsion and auxiliary equipment will go off. In this case it will be necessary to manually complete the changeover as follows:

a. Open No. 2 electric locker. Confirm changeover failure by observing vacuum interrupter light (VIOL) on.

b. Operate manual changeover switch one complete rotation counterclockwise from OFF to OFF when going from 11KV to 25KV, or one complete rotation clockwise from OFF to OFF when going from 25KV to 11KV.

c. Observe tap changer low or high light come ON as VIOL goes OFF.

d. Car systems will be reactivated. Proceed with run. Make prompt report of changeover failure to appropriate person.

7. Changing Operating Station

When leaving one cab to go to another:

a. Place master controller in center SAFETY position and release deadman foot switch. This applies emergency air brakes on the train.

b. Remove automatic air brake handle as described in section II, B of this manual.

c. Remove control plug from master controller.

d. At new cab, proceed as in section III, B for starting a car or train.

C. LAY-OVER INSTRUCTIONS

1. Layover

a. Place master controller in center SAFETY position and release deadman foot switch. This applies emergency air brakes on the train.

b. Place brake valve cutout valve in OUT position.

c. Remove automatic brake handle.

d. Remove control plug from the master controller.

e. Turn off headlights, windshield wiper and cab heat if in use.

f. Turn off vestibule and clearance lights. Leave marker lights ON at front and rear of train in accordance with Railroad Operating instructions.

g. Set hand brakes on desired cars sufficient to hold the train.

h. Turn off car interior lights.

i. Leave all circuit breakers on. Layover heat will function so long as there is power to the cars in the train.

j. Close all doors on the train. Leave the train and close last side entrance door with a coach key using the outside key switch.

2. Shutdown

To shut down cars completely, follow the instructions in paragraph C, 1, items a through g and also perform the following:

a. Close all doors on the train.

b. Lower all pantographs.

c. Turn off all circuit breakers in the B end circuit breaker panel in each car except the door motor circuit breakers.

d. Turn off the battery trainline breaker in the No. 2 electric locker.

e. Leave the train and close last side entrance door with a coach key using the outside key switch.

D. COUPLING AND UNCOUPLING CARS (Figure 5-4)

These cars have a coupler which is fully automatic and which cannot be coupled to other railroad equipment without the use of an adaptor, see section V,E.

The N-2A automatic car coupler is a notched male device with a companion female fitting. The coupler at both ends of a single car and the B end of married pair cars is a fully automatic version which makes mechanical, pneumatic and electrical connections between the cars automatically. The coupler at the A end of married pairs cars is similar but does not include an electrical head, all electrical connections between mate cars being made by jumper cables.

1. Coupling

Assuming that the cars to be moved are set for normal operation, the following procedure should be followed for coupling.

a. When coupling on other than level tangent track, a crewman should descend to the roadbed to make sure the couplers are within gathering range of each other, that is, the couplers are positioned where the tip of the notched male pin is within the cone area of the mating female fitting on the opposite coupler. If possible, avoid coupling up on sharp curves or turn outs.

b. Close all doors. Green door closed light on console should be lit. Move close to the other cars, holding the deadman down and manipulating the master controller and brake as required.

c. Make a safety stop before coupling and check to see that couplers are within gathering range, then bring the cars together gently.

d. Stretch train to insure coupling is made.

e. Connect the safety gates between the pairs.

f. Since the brake pipe was discharged on the added cars, an emergency application will occur as cars couple. A 45 second delay must be observed before recharging to allow the emergency valves to close. Recharge the brake pipe.

NOTE: If the MA set and air compressor are not in operation on the standing cars they should be started before recharging the the brake pipe.

g. A brake test as outlined in section III A2 should be performed on all cars prior to departure.

h. Release handbrakes on added cars.

2. If necessary to couple on curves:

   a. Manually disconnect centering springs.

   b. Move couplers to desired position by hand.

   c. Couple up.

   d. Reconnect centering springs.

3. Power uncoupling

   a. Initiate uncoupling from the car which is pulling clear as the brake pipe valve is closed only on the car from which uncoupling is initiated, allowing the standing car to go into emergency brake as the cars separate. Propulsion control is broken when the couplers are released allowing the cars to separate.

b. The Engineman or trainman presses the uncoupling button in the cab next to the point of separation and holds it down while the cars are separated. The button is released when separation is accomplished.

NOTE: Separation of mechanical, air and electrical trainlines is accomplished automatically at uncoupling.

c. An exterior uncoupling button, located on each side of each end of the "single" cars and on each side of the "B" end of the married pair cars, may be used by a crewman on the ground. This uncoupling is used in the same manner as the one in the cab.

NOTE: All cars behind the uncoupling will go into emergency brake application as couplers separate. Cars ahead of the uncoupling are under the operational control of the Engineman.

Standing group of cars must be activated by inserting a control plug in any cab.

4. Manual Uncoupling

a. Turn out the manual uncoupling bolt located on the right side of each coupler. The bolt cannot be removed entirely, but will turn out enough to unlatch the mechanical notched (male) device so that uncoupling is accomplished.

b. Both uncouplers must be released as the coupling is a double lock arrangement.

NOTE: In an emergency, when proper tools are not available, the notch in the retainer plate for the coupler adapter may be used as a wrench to uncouple manually.

5. Manual Electrical Isolation

Should an electrical fault on one or more cars in a train prevent movement of the train, the defective cars may be isolated from the trainline controls by manually retracting both electrical coupler heads at the defective cars.

a. Move the electrical uncoupling levers back to a retracted position. Raise the locking pins to hold the levers in this position.

E. COMMUNICATIONS OPERATION

The communication and public address equipment provides two way communications between the engineman and wayside stations (Radio); two way communications between the engineman and conductor at different train locations (Radio); and one way communication between the engineman or conductor and the passengers (PA).

The communications control unit is located in the cab on the left vertical indicator and switch panel. The handset has a press-to-talk switch, depressed when transmitting and released when receiving. Indicator lights show whether the system is activated, TNX ON, in the radio mode, Radio ON, or in the public address mode, PA ON. A frequency selector may be set at one of four channels to talk to wayside stations. A small speaker on the panel allows the engineman to hear all transmissions. A volume control knob allows adjustment of this speaker volume. There are speakers located in each car interspersed between the lighting fixtures in the ceiling. Volume is preset and not adjustable from the cab.

1. Communications System Activation

   a. In the operating cab, place a control plug in the control opening. This will activate the communications system. The white radio light will come on indicating system is in the radio mode.

   b. To activate a communications control panel in a cab other than the operating cab, place a door key in the door control panel directly behind the cab and turn it ON. The white radio light will come on.

2. Radio Communications Procedure

   a. The radio is normally in receive.

   b. The panel speaker will monitor all radio reception.

   c. Make sure radio is set to the correct channel. Radio light should be on.

   d. To transmit, lift the handset out of the cradle and hold the press-to-talk button down.

   NOTE: An engineman and trainman may carry on a two way communication over the train radio using the handset on two activated communications control panels.

3. Public Address (PA) Procedure

   a. Lift handset from the cradle.

   b. Push PA pushbutton/light. Radio light will go out. PA light will come on.

   c. Depress press-to-talk button to speak through PA system on the train.

   d. Replacing handset in holder automatically returns the system to the RADIO mode. PA light will go out. RADIO light will come on.

4. Communications System Deactivation

   a. To deactivate the system, remove the control plug from the control opening. The RADIO light will go out.

   b. If the communications control panel was activated by a coach key, place a coach key in the door control panel and turn it OFF. The RADIO light will go out indicating system deactivation.

F. TEMPERATURE CONTROL OPERATION

Heating, cooling and ventilation are provided by a combination of the overhead air conditioning/ heating system and the floor heat system. The temperature control system is fully automatic and requires no adjustment by the crew.

1. Activating the System

   a. Make sure the heat and air conditioning circuit breaker, in the B end circuit breaker panel, is ON.

   b. Place control plug in the control opening. This picks up trainline relays in each car and activates the heating and air conditioning system.

2. Layover Heat Control

   a. Removing the control plug from the control opening in the master controller, places the train in layover heat. The heat and air conditioning circuit breaker must be ON. Layover heat is automatic when inside temperature is less than 68 F.

3. Cab Heat Control

   a. Cab heat and windshield defrosting are activated by placing the cab heat switch in the HIGH or LOW position. Heat and air conditioning circuit breaker must be on. Cab heat and defrosting will be constant when switch is on high or low.

   b. Microswitch at left of top center cab panel cuts out cab heater when vestibule end door is swung inward and latched over the cab controls.

4. Deactivating the Temperature Control System

   a. Removing the control plug from the control opening in the master controller deactivates the train heating and air conditioning and returns the system to layover heat.

b. In case of a failure in the equipment, the temperature control system in each car may be shut down by setting the heating and air conditioning circuit breaker to OFF. Overload protection of heaters and air conditioning equipment is provided by circuit breakers located underfloor. To completely shut down the system, set all system circuit breakers to the OFF position.

3

G. DOOR CONTROL OPERATION (Figure 2-11)

The door control system on a train is operated from door control panels located in the vestibule at the B and A ends of each car. The door control panels on each side of the train control the doors on their respective sides.

1. Door Opening Procedure

   a. Make sure door control and door motor circuit breakers are ON in each car.

   b. Insert a coach key in door control panel on desired side of car. Turn key one quarter turn clockwise to activate the panel.

   c. When train is stopped, trainman may open doors ahead of or to the rear of his position independently by momentarily pressing the appropriate OPEN (RED) push button.

d. Trainman may open the door at which he is standing by pressing the OPEN THIS DOOR push button.

e. If all OPEN push buttons are pressed, all doors on that side of the train will open except the one at the operating cab (Control plug in control opening).

f. Door at the operating cab, control plug in, can be opened only by using OPEN THIS DOOR push button in that door control panel when activated by a coach key.

2. Door Closing Procedure

a. Press the appropriate CLOSE (GREEN) buttons. A passenger warning bell will sound for two seconds. The doors will start to close one second later.

b. Doors may be closed from any activated door control panel on the appropriate side of the train.

NOTE: Only one door control panel on each side of the train should be activated at one time.

3. Low Level (Trap) Door Operation

To Open, Train Stopped:

a. Open desired side entrance doors on either or both sides of the train from appropriate door control panels.

b. Go throughout the train and raise and latch desired trap doors.

c. Close remaining side entrance doors from appropriate door control panels. Those doors with the trap door latched up will remain open. Door closed light in the cab will light.

d. Train may then be started.

To Open, Train Moving:

a. At each door which is desired open, insert a coach key in the door control panel and turn to ON.

b. Press OPEN THIS DOOR push button. That door will open.

c. Lift and latch trap door.

d. Turn coach key in door control panel to OFF and remove coach key.

CAUTION: If coach key is removed before trap door is raised and latched, traction power on the train will be shut off.

To Close, Train Stopped:

a. Lower all trap doors on doors to be closed.

b. Close all doors from an appropriate door control panel. Those doors with trap door up and latched will remain open.

c. When all doors are closed except low level, doors closed light will come on in cab and train can take power.

To Close, Train Moving:

a. At each door to be closed, insert a coach key in the door control panel and turn ON.

b. Lower trap door.

c. Press CLOSE THIS DOOR push button. Door will close.

NOTE: There is no warning bell or time delay for "this door".

d. Turn coach key in door control panel to OFF and remove coach key.

> **CAUTION:** If trap door is lowered before that door control panel is activated, traction power on the train will be shut off.

4. Door Hold Closed Function

The door override foot switch located on the cab floor on the right, allows the engineman to remove power from all door opening circuits activated through door control panels. Depressing the DOOR OVERRIDE foot switch prevents the doors from being opened by a trainman. The OPEN pushbutton must be pressed after the DOOR OVERRIDE foot switch is released, to open the doors.

5. Door Trainline Cutoff Switch

The two-position cutoff switch is located in the trainline panel at the A and B ends of a car. For trainline operation the cutoff switch is set to the THRU ON position. For deadheading operation the switch at the point where control is to be broken is set to OFF.

6. Door Operator Cutout Switch

A door operator on-off switch mounted directly on each door operator permits the motor to be cutout if necessary. Door trainlines are still active when this switch is used to cut out a faulty door operator.

7. Door Signal System

a. Local Door Indicating Lights. A red indicating light is mounted outside on each side of the car to the rear of the cab, above the windows. The indicating lights may be seen from both ends of the train. The indicating lights on a car are lighted when any end entrance door on that car is not fully closed. These indicating lights will not be lit when a door is open and the low level trap door is latched up.

b. Engineman's Door Closed Light. This light is active in all cabs in the train. When lit, it indicates all side entrance doors are closed. If the light is out, the train will not take power. Doors which are open with the low level trap door latched up bypass this light circuit. The light has a green lens and an adjustable shutter to regulate lamp brilliance. It has a press-to-test feature to see if the lamp is good.

8. Door Interlock Switch

The door interlock switch, when activated, provides an emergency bypass for the trainlined interlock circuits which remove propulsion control when any door is open. In the event of an entrance door interlock circuit failure, the engineman can move the train after switching the door interlock switch to ON. This switch is to be used in accordance with Railroad Operating Instructions.

H. SIGNAL BUZZER OPERATION

The signal buzzer system permits the train crew to signal each other as required.

The buzzer in all cabs in the train may be sounded by pressing any one of the continuously activated buzzer push buttons. These are located in the ceiling of the vestibule on both sides of the car. Four more buzzer push buttons are located on the outside of the cars between the end of the car and the stairwells. They are activated at all times and are accessible from the ground.

The signal buzzer system is activated whenever the trainline control and fault protection circuit breaker is ON.

IV. OPERATING SUBSYSTEMS

A. ELECTRICAL SYSTEM

1. Main Control Apparatus

Each car has four traction motors and a separate set of traction control equipment. Motor current is automatically regulated to produce the power or dynamic braking rate called for by the train-lined commands from the controlling cab and its associated equipment. An air brake system supplements dynamic braking during normal operation using automatic blending controls but has sufficient capacity to handle the entire braking load in the event of a failure in dynamic braking.

An overhead catenary supplies electrical power for traction, main heat, and the motor alternator. A jumper cable provides 11,000 VAC between the "A" and "B" car. A pantograph is located on each single car and the "B" car of a married pair.

2. Propulsion and Dynamic Braking

The propulsion and dynamic braking system is the same for single cars and for both "A" and "B" cars. Each axle is powered and braked by a separate traction motor supplemented by two wheel tread brake units.

In the Power Mode, the traction motors are initially connected in a series parallel configuration and current through the traction motors is regulated by controlling the operation of two ignitron tubes. The output of the ignitron tubes is fed into rectifier panels which rectify the AC to pulsating DC current which is smoothed by the main smoothing reactor and then supplied to the traction motors. A main transformer is used to couple the 11,000 volt AC catenary voltage to three secondary windings used for the propulsion system.

Dynamic braking is of the non-regenerative type using braking resistors to dissipate the electrical energy produced by the traction motors. The braking resistors are cut in or out by cam operated switches to provide smooth deceleration during dynamic braking.

Outside source voltages are not utilized, however electrical energy generated by the rotating traction motors is utilized to effect dynamic braking of the car. The traction motors are connected in two closed loop circuits. Resistance is gradually removed to maintain the braking effort. The speed at which resistance is removed determines the rate of deceleration or braking. These rates are a function of preset rate circuits.

a. Load Meter. A traction motor current meter is provided in each cab to indicate dynamic brake and motoring current of the car.

b. Brake/Motor Cutout Switch. Cuts out the dynamic brake and the motors on a car if necessary. This does not affect trainline operating control of a train.

c. Trainline Dynamic Brake Cutout Switch. Cuts out dynamic brake on all cars in a train. Automatic air braking only will be available. This switch is active only in operating cab.

d. Control. If a failure occurs in any of the controls in the lead cab such as the master controller, the train may be operated from another cab, in accordance with Railroad operating instructions.

3. Wheel Slip-Slide Protection System

a. Wheel Slip-Slide Protection

The wheel slip-slide system detects wheel slip and slide by measuring the rpm of each axle. The speeds of the four axles are compared to determine whether there is a difference in speed.

A slip or slide condition is corrected automatically, independent of engineman, by reducing motoring or braking tractive effort on the car which is losing adhesion, and by momentarily releasing the air brakes (when braking) on the individual truck which may be sliding.

When slipping occurs during acceleration, traction motor power is reduced on the entire car. When slipping stops, traction power is slowly re-applied.

When sliding occurs during deceleration, at dynamic brake speeds, braking will be reduced until the differential wheel speed is corrected. Air brake cylinder pressure will be momentarily released on the truck where the slide occurring by means of a dump magnet valve and dynamic braking will be removed. When sliding in this condition stops, brake cylinder pressure will be restored to normal and dynamic braking will be restored.

b. Synchronous Slip-Slide Protection

A synchronous slip or slide is when all four axles on a car slip or slide at the same rate. The synchronous slip-slide protection system detects a slip or slide by monitoring the rate of change of axle speed. If axle speed increases too fast (indicating a slip) or decreases too fast (indicating a slide), corrective action is taken automatically by the system.

4. Auxiliary Control Apparatus

a. Motor Alternator

A motor alternator supplies power for air conditioning and ventilation, battery charging, and feeds the 38 volt battery circuits through a static (transformer and rectifier) converter.

b. Battery

The battery circuit supplies power for emergency lighting, head lights, markers, interior lighting, door operators, door controls, instrument lights, heating and air conditioning controls, traction controls, signal lights, exhaust fans and auxiliary controls.

c. Overload Protection and Reset

Propulsion and dynamic brake circuits are protected by overload devices which will open the traction motor circuit on the respective car in the event of an overload, thus removing power. An overload is indicated by a FAULT light in the cab. Overloads may be reset in the following way: Take the CONTROL plug from the control opening and place it momentarily in RESET opening. Then return the plug to the CONTROL opening.

B. AUTOMATIC AIR BRAKE SYSTEM

The pneumatic brake system is an automatic air brake incorporating an electro-pneumatic feature which increases the application response and graduated release capabilities of the automatic air brake.

1. Service Brake

The air brake operates normally in conjunction with a dynamic brake system during service brake applications. The dynamic braking effort is effective from maximum speed to approximately 15 MPH fade point. The air brake supplements the dynamic brake and is automatically blended as required to maintain a selected rate of deceleration. An initial inshot of air is admitted to the brake cylinders when dynamic brakes are in operation, to bring the brake shoes in contact with the wheel tread and to assist in synchronizing and blending of the air brake with dynamic brake when dynamic fades out.

When a brake rate is selected beyond the capability of the dynamic brake, the dynamic will be automatically supplemented by the airbrake system.

In the event of partial or complete loss of the dynamic brake, the air brakes will automatically respond to the engineman's brake call and produce the required rate of deceleration.

The automatic air brake is capable of graduated service application or release under control of the engineman by movement of the brake valve handle through the SERVICE: LAP: HOLD and RELEASE positions. Wheel slip/slide protection will temporarily reduce both dynamic and pneumatic braking effort on each car that detects a wheel slide. Traction power will be cut off immediately upon reaching the SERVICE position or after an initial 7 PSI reduction of brake pipe or when brake cylinder pressure reaches 30 PSI.

Brake cylinder pressure (BCP) is developed at the tread brake units through the reduction of equalizing reservoir pressure (ER) and subsequently brake pipe pressure (BP) by placing the brake valve handle in the SERVICE position. The relationship of increasing BCP to decreasing BP is 2 1/2 to 1, i.e.; a ten pound (10 PSI) reduction of BP will produce twenty-five pounds (25 PSI) of BCP. A full service brake application is made by reducing BP by 26 PSI, which will assure that maximum development of approximately 65 PSI of BCP. Any further reduction of BP will not increase service BCP beyond the established limit of approximately 65 PSI. Completely exhausting the brake pipe will cause an emergency brake application of 90 to 100 PSI BCP depending upon the load weight of the car.

When the selected service reduction (automatic air brake) of BP has been made and the desired level of BCP has been attained, the pressures are held at these levels by placing the brake valve handle in LAP or HOLD position (when operating electro-pneumatically).

In order to restore ER and BP to the original value of 110 PSI, the brake valve handle is placed either in the HOLD or RELEASE position. With the electro-pneumatic switch in OFF, these two positions produce the same result of restoring ER and BP while releasing the brakes by reducing BCP. When the electro-pneumatic switch is ON, the HOLD position allows BCP to be maintained while restoring ER and BP.

2. Emergency Brake

Emergency brake applications are made by a rapid reduction of brake pipe pressure which will trigger valves that will completely exhaust the brake pipe. There is a forty-five second time delay before the brake pipe can be recharged following an emergency brake application.

Pneumatic initiated emergency brake applications can be made from any cab by placing the brake valve handle to the EMERGENCY position (normally the brake valve handle is removed from non-operating cabs) and can also be initiated from the passenger's compartment with the conductor's emergency valve.

Electrically initiated emergency brake applications are made whenever the master controller handle in the operating cab is allowed to return to the SAFETY position (except when service BCP is 60 psi or the safety control (deadman depressed), or if the control plug is removed from the CONTROL receptacle for longer than six seconds. Whenever cab signal is in use and the engineman fails to acknowledge a restrictive warning within six seconds an emergency brake application will result.

Single cars are equipped with an additional and separate emergency brake system, the SINGLE CAR EMERGENCY. Single car emergency is initiated by pressing a red button in the operating cab or whenever main reservoir pressure drops below 67 PSI. Single car emergency brake applications can only be made on an individual single car with an operating cab. In order to release the brakes following an application, main reservoir pressure must be above 67 PSI and the single car emergency brake valve (red button) must be closed (OUT).

During all emergency brake applications, propulsion and dynamic brake are locked out. Wheel slip/slide protection is nullified during deadman and single car emergency brake applications.

3. Air Brake Equipment

AIR COMPRESSOR - An air compressor on each single car and the B-car of a married pair supplies air compressed to 130-140 PSI to two main reservoirs on each car.

MAIN RESERVOIRS - The first main reservoir stores air for use by the auxiliaries on the car and feeds a trainlined main reservoir equalizing pipe. The air stored in the second main reservoir is reserved for the operation of the air brakes. Brake pipe pressure developed from the second main reservoir under control of equalizing reservoir pressure is fed to a trainlined brake pipe.

EQUALIZING RESERVOIR - The equalizing reservoir stores air regulated to 110 PSI for control of the development of brake pipe pressure.

MAIN RESERVOIR EQUALIZING PIPE - The main reservoir equalizing pipe is a 1 inch iron pipe that is trainlined through the automatic couplers and is equipped with cutout cocks at each end of the car.

BRAKE PIPE - The brake pipe is a 1 1/4 inch iron pipe that is trainlined through the automatic couplers and is equipped with cutout cocks at each end of the car. A flexible hose extension of the brake pipe is provided at the cab ends and is equipped with a cutout cock and gladhand which allows the brake pipe to be connected to the brake pipe of a locomotive.

PS-68-C BRAKE VALVE - Mounted on a pipe bracket in the cab, the engineman's brake valve controls equalizing reservoir pressure which causes reductions and increases in brake pipe pressure to apply and release the brakes. An electric drum switch on the brake valve generates signals for dynamic brake and electro-pneumatic operation. A charging reset valve and a brake valve cutoff valve are located at the base of the brake valve.

BRAKE VALVE CUT-OFF VALVE - When turned from the OFF to the IN position the brake valve cut-off valve sets up the brake valve for operation of the brakes from that cab.

RESET VALVE - The reset valve is used to charge the brake pipe to 110 PSI. The reset valve must be held depressed until brake pipe pressure reaches 80 PSI.

NY-2 RELAY VALVE - Located at the cab ends in the passenger compartment under a seat, the NY-2 valve meters second main reservoir pressure for the development of brake pipe pressure in response to changes in equalizing reservoir pressure.

REGULATING VALVE - Located at the B-end of the car on a pipe bracket with the NY-2 relay valve, the regulating valve regulates second main reservoir air to 110 PSI to supply the equalizing reservoir.

CAB CONTROL UNIT - Located underfloor at the cab ends, the cab control unit is a pipe bracket that mounts the following devices: an equalizing reservoir, a brake pipe cut-off valve, and FA-4 magnet valve, an HB-5 relayair valve and a dead engine fixture.

BRAKE PIPE CUT-OFF VALVE - Prevents the NY-2 relay from restoring brake pipe pressure during emergency brake applications by cutting off the brake pipe from the NY-2.

FA-4 MAGNET VALVE - A normally energized magnet valve which causes an emergency brake application when de-energized. The FA-4 becomes de-energized when the master controller is in the SAFETY position, (when BCP is less than 60 psi or without depressing safety control (deadman) pedal) or the control plug is removed for more than six seconds or if a cab signal restriction is not acknowledged within six seconds.

HB-5 RELAYAIR VALVE - A stop assuring device that prevents recharging the brake pipe and releasing the brakes for a period of forty-five seconds following an emergency brake application.

DEAD ENGINE FIXTURE - The dead engine fixture is a check valve that supplies air to the second main reservoir from the brake pipe for operation of the air brakes from a towing locomotive. The fixture is equipped with a cut-out handle and is located on the cab control unit at the B-end of the car. The handle is left in the normal vertical position for towing.

BRAKE CONTROL UNIT - Located underfloor at the center of the car on the right hand side, the brake control unit is a pipe bracket that mounts the following devices: a cut-out cock, a snow-brake reducing valve, magnet valve and cut-out cock, a 26-C control valve, a J-1 relay valve, a KM-2 vent valve, a variable load valve, a blending valve, an H-5 relayair valve, and the service and release magnet.

CUT-OUT COCK - Moving the handle, located on the control unit, from the vertical to the horizontal position will cut out brake operation on the car.

SNOW BRAKE REDUCING VALVE - Reduces main reservoir pressure to 8 PSI snow brake pressure.

SNOW BRAKE MAGNET VALVE - When energized by a switch in the cab, the snow brake magnet valve applies 8 PSI brake cylinder pressure to prevent the accumulation of ice on the brake shoes.

SNOW BRAKE CUT-OUT COCK - Moving the handle, located on the control unit, to the extreme right will cut out snow brake operation on the car

26-C CONTROL VALVE - Develops control air in response to changes in brake pipe pressure to produce a brake call signal that determines the level of dynamic brake and/or air brake to be applied. Regulates maximum service brake call to 65 PSI brake cylinder pressure and limits emergency brake call to 100 PSI brake cylinder pressure.

J-1 RELAY VALVE - Responds to control pressure from the 26-C control valve and meters main reservoir air to the brake cylinders proportionate to brake call.

KM-2 VENT VALVE - The KM-2 vent valve is triggered by a rapid reduction of brake pipe pressure and functions to quickly propagate an emergency brake application by further reducing brake pipe pressure locally through a large exhaust port.

VARIABLE LOAD VALVE - Varies emergency brake cylinder pressure from 90 to 100 PSI depending upon changes in air spring pressure in response to the passenger load weight of the car.

BLENDING VALVE - Proportions service brake cylinder pressure in response to the amount of dynamic brake effort being produced compared to the total effort being called for.

H-5 RELAYAIR VALVE - Allows brake cylinder pressure to bypass the blending valve during emergency brake applications.

SERVICE MAGNET VALVE - During electro-pneumatic operation the service magnet valve creates quick response of brake applications by venting brake pipe pressure at the brake control unit when energized by placing the brake valve handle in the SERVICE position.

RELEASE MAGNET VALVE - During electro-pneumatic operation the release magnet valve prevents brake cylinder pressure from releasing when energized by placing the brake valve handle in the HOLD position. Electrically controlled graduated releases are obtained by alternately moving the brake valve handle between RELEASE and HOLD sequentially de-energizing and energizing the magnet valve.

REDUCTION RELAY VALVE - The reduction relay valve consists of a KM-2 vent valve and a B-1 quick service valve mounted on a pipe bracket located underfloor at the B-end of the car. The B-1 valve provides a local exhaust for propagation of reductions in brake pipe pressure during service applications, while the KM-2 serves the same purpose during emergency applications.

B-3-B CONDUCTORS EMERGENCY VALVE - The conductors valve provides a means of applying the emergency brake from the passenger compartment. Located over each body end door, a conductors valve can be actuated by pulling a handle suspended above the door.

BRAKE CYLINDER CUT-OUT COCK - Located under the side sill at each truck the BC cut-out cock will cut out BC pressure to the truck and exhaust BC pressure from the tread brake units when the handle is turned to the horizontal position.

AIR SPRING CUT-OUT COCKS - Located under the side sill there are two of these cocks at each truck. One cock will cut out main reservoir air supply to the air springs and the other will cut out brake pipe air supply to the air springs when the handles are turned to the horizontal position.

SINGLE CAR EMERGENCY BRAKE UNIT - Located at each truck on single cars only, these units provide an additional emergency brake capability operating from main reservoir supply.

SINGLE CAR EMERGENCY BRAKE VALVE - The SEBV is a red button located in the cab of single cars only which will apply the single car emergency brake when pressed.

C. COMMUNICATIONS SYSTEM

4

The communication and public address equipment provides two way communications between the engineman and wayside stations (Radio); two way communications between the engineman and conductor at different train locations (Radio); and one way communication between the engineman or conductor and the passengers (PA).

The communication control unit is located in the cab on the left vertical indicator and switch panel. The handset has a press-to-talk switch, depressed when transmitting and released when receiving. Indicator lights show whether the system is activated, TNX ON, in the radio mode, Radio ON, or in the public address mode, PA ON. A frequency selector may be set at one of four channels to talk to wayside stations. A small speaker on the panel allows the engineman to hear all transmissions. A volume control knob allows adjustment of this speaker volume. There are speakers located in each car interspersed between the lighting fixtures in the ceiling. Volume is preset and not adjustable from the cab.

D. CAR LIGHTING SYSTEM

1. Exterior Indicator Lights

In addition to the headlights and marker lights on each car, other exterior lights function as indicators and include:

a. Door indicator lights - red when any doors on that car are open. These lights will not be lit when a door is open and the low level trap door is latched up.

b. Brake indicator lights - amber when brakes are applied, and green when brakes are released on that car.

c. No power light - white when car fails to take propulsion power.

2. Interior Lights

The interior lighting system consists of three main fluorescent lighting circuits on 230V, single phase power, with the lights mounted in the ceiling of the car. There is an emergency system of incandescent lights on 38 VDC power.

Turning on the switches of any of the three main interior lighting circuits activates the emergency lighting system. The emergency lighting system will then go on in case motor alternator output drops below 160 volts.

NOTE: On Reading cars, the No. 3 main lighting circuit is also on 38 VDC power and will also remain on if MA output drops below 160 volts.

E. TEMPERATURE CONTROL SYSTEM

General

Heating, cooling and ventilation are provided by a combination of the overhead air conditioning and heating system and the floor heat system. The two overhead evaporator fans located in the low ceiling at each end of the car draw return air from the car, mix fresh outside air in a specific proportion, and then cool and/or heat the air to maintain interior temperature and humidity at a comfortable level. The floor heating system supplements the overhead heating system when outside temperatures drop below predetermined levels.

Humidity is reduced in warm weather by first chilling the air to condense moisture, then reheating the air to a comfortable temperature. A portion of air is exhausted through the fresh air ducts to remove stale air from the car.

The temperature control system is fully automatic and requires no adjustment by the crew. Heating and cooling equipment is cycled on-off automatically by the heating and cooling control thermostats.

F. DOOR CONTROL SYSTEM

General

Door control panels are located on each side of the car in the vestibules. Normal trainline operation of the door control system from the door control panels is possible whenever the train is stopped and the no motion relay in each pair of cars is picked up. (The signal light circuits, however, remain operable whether or not the train is in motion.) The door control circuit breaker and door motor circuit breaker must be set to the ON position for normal operation.

The door opening and closing signals are originated by the trainman at a door control panel. The trainman will activate the door control panel by coach key on that side of the train on which he desires to open or close the doors.

Two protective interlock circuits are provided for the doors. A trainlined door closed interlock will prevent the engineman from taking power if a door fails to close. The green door closed light in the cab is operated through this circuit. The second interlock is the no motion interlock which removes door power while the train is moving.

Trap door heaters and door track heaters operating on alternating current are provided to prevent fouling of the door tracks. These are regulated by a thermostat.

SEPTA CARS ON ROAD TROUBLE SHOOTING

READING COMPANY MU CARS 9018-9031 PENN CENTRAL MU CARS 270-399

A. ELECTRICAL DIFFICULTIES

TROUBLE	SYMPTOM	CAUSE	REMEDY
1. Trolly wire de-energized	Fault light lit and cannot be reset from cab.	THR tripped in Main Group of car with THL light lit	Manually reset THR or turn local pantograph down switch on car to DOWN position.
	Fault light not lit & one pantograph in train has lowered	PLR tripped in Main Group of car with lowered pantograph or A-car of married pair.	Manually reset PLR & raise pantograph or operate with pantograph lowered on that car or pair of cars.
(All blowers, stopped interior lights & air cond. out)		Tap changer remains in 11KV position in 25KV territory. Vacuum interrupter open	Rotate manual changeover switch counterclockwise one complete rotation from OFF to OFF on car with VIOL light lit.

TROUBLE	SYMPTOM	CAUSE	REMEDY
2. All pantographs lowered.	All blowers stopped. Interior lights and air cond. out.	Pantograph lower switch closed.	Check switches in train. Turn switches to OFF and raise pantographs
3. Train will not take power.	Brake released lights not lit.	Brake not released on car or cars in train.	Refer to para. 7 and 8.
	Door closed light not lit.	Passenger entrance door open.	Refer to para. 12, 13, 14 & 15.
		Door limit switch inoperative.	Check that doors are closed and turn interlock switch on in operating cab.
	Both of the above lights lit.	Master controller handle in power position when doors close.	Return control handle to OFF and then reselect power position.
		Brake pipe pressure below 110 psi.	Adjust ER regulating valve or operate from second car.

TROUBLE	SYMPTOM	CAUSE	REMEDY
		Electrical problems	Operate from second car or pair of cars.
	Both of the above lights are not lit.	Cover door on coupler at rear of train not completely closed.	Close coupler cover door or retract coupler head.
		Tripped trainline control circuit breaker.	Check vestibule circuit breaker panel on all cars in train.
		Coupler head is retracted between coupled cars.	Release electric head
4. No traction power or reduced motoring on one car.	MA and blowers are operating.	Fault light lit due to an overload condition.	Reset using control plug to extinguish fault light and regain full traction power.
		Fault light lit due to a ground condition.	Reset ground relay using control plug and manually reset RGR in Main Group having local ground light (LGL) lit to extinguish fault light and regain full traction power.

TROUBLE	SYMPTOM	CAUSE	REMEDY
		Motor cut-out switch in cutout position.	Turn switch to NORM position and reset local no power reset switch to extinguish fault and no power lights.
		Fault light and no power light lit. Blown fuse TF-1 or TF-2 in Auxiliary Group	Install spare fuse.
		Coupler electric head retracted.	Release electric head.
		Tripped traction control circuit breaker.	Reset breaker in vestibule circuit breaker panel.
		Loose trainline jumper between A and B car.	Properly insert jumpers.
		Loose electronic card in No. 1 electric locker.	Check that all cards are securely in place.

TROUBLE	SYMPTOM	CAUSE	REMEDY
5. No traction power on one car.	MA and blowers not operating.	Tripped auxiliary control circuit breaker.	Reset breaker in vestibule circuit breaker panel.
		Tripped automatic changeover circuit breaker.	Reset breaker in vestibule circuit breaker panel.
		Check auxiliary group for:	
		Tripped circuit breakers	Reset any circuit breakers found tripped
		OSR relay tripped	Reset OSR
		OVR relay tripped	Reset OVR
		TPF relay tripped	Reset TPF
		OL13 overload tripped	Reset OL13 and TPF
		OL46 overload tripped	Reset OL46 and TPF

TROUBLE	SYMPTOM	CAUSE	REMEDY
		Cover open on stand-by receptacle on either side of car.	Close cover and reset MPWB circuit breaker in auxiliary group and TPF.
		MA overload tripped	Press local reset switch (LRS) in Main Group.
		Loose MA electronic card in No. 1 electric locker.	Check that all cards are securely in place.
		Changeover switch in wrong position and vacuum interrupter open.	Rotate manual changeover switch clockwise or counterclockwise one complete turn (to OFF) to extinguish VIOL light in No. 2 Electric locker.
	MA will not start after checking all of the above.	Dead battery.	Press MA manual start switch in Auxiliary Group and hold until MA reaches operating speed.
	MA will not start using manual start switch	Blown MSF fuse.	Install spare fuse.

B. BRAKE DIFFICULTIES (Figure 5-1)

TROUBLE	SYMPTOM	CAUSE	REMEDY
6. Air compressor stopped.	Main reservoir pressure drop.	Tripped ACB breaker.	Reset breaker in vestibule circuit breaker panel on single or B car.
		Tripped ACCB breaker.	Reset breaker in Main Group on single cars. Reset breaker in Auxiliary Group on B cars.
		Tripped ARBB breaker.	Reset breaker in Auxiliary Group on B cars.
		Tripped hi-temp cutout switch.	Reset switch on A end of com-compressor.
		MA and blowers not operating on single cars & A cars.	Reset MA and blowers. Refer to para 5.
		Blowers not operating on B cars.	Reset blowers. Refer to para 5. (If unable to start blowers, the EACS switch may be used on B cars to run air compressor.)

TROUBLE	SYMPTOM	CAUSE	REMEDY
7. Brakes fail to release on one car.	Brakes released light not lit and train will not take power.	Cutout cock closed on brake control unit.	Locate car with brake applied light lit and open cutout cock or close brake cylinder cutout cocks.
(Indicated by brake applied light being lit on that car).		Brake cylinder not releasing.	Close brake cylinder cutout cocks.
		Brake cylinder pressure switch inoperative.	Check that brakes are released, retract both coupler heads and operate from longest section of train.
	100 psi BCP on car with operative cab.	Single car emergency valve open on either end of car.	Close valve.
	Handbrake light lit.	Handbrake applied.	Release handbrake on car with light lit in cab.

TROUBLE	SYMPTOM	CAUSE	REMEDY
8. Brakes fail to release on all or part of train.	Brakes released light OFF and brakes applied lights ON	Brake pipe cutout cock not open at end of first car with applied lights lit.	Open cock.
Unable to charge brake pipe to 110 psi.	Blow at FA-4 valve	Master controller in safety position.	Place controller in OFF position.
		DC-DC converter circuit breaker tripped at operating station.	Reset circuit breaker in vestibule circuit breaker panel.
		Electrical problems.	Operate from second car.
	Low equalizing reservoir pressure	Defective regulating valve.	Adjust or operate from second car.
	Blow of air at a brake valve.	Conductor's emergency valve open on that car.	Close conductor's valve.
		Brake valve cut IN in another cab.	Place brake valve cut off valve in OUT position.
	Blow at KM-2 vent valve.	Defective vent valve.	Plug vent valve.
	Air leak between couplers.	Defective gaskets or coupler hose.	Close BP cocks between cars, connect gladhands, open angle cocks.

TROUBLE	SYMPTOM	CAUSE	REMEDY
9. Undesired emergency application of brakes during service application.	All brakes applied.	Safety control application Defective KM-2 vent valve.	Recover control. Apply brakes in stages or plug vent valve.
	Brakes applied on one car during electro-pneumatic operation.	Cutout cock closed on brake control unit.	Open cutout cock or close brake cylinder cutout cocks.
10. Brake pipe charges higher than equalizing reservoir pressure.	Brakes slow to apply, unable to reach maximum service brake.	Defective dead engine fixture.	Cutout dead engine fixture one at a time until brake pipe reduces to 110 psi.
11. Loss of main reservoir pressure	Air leak between couplers.	Defective gaskets or broken air hose.	Close main reservoir cocks between cars.

DOOR DIFFICULTIES (Figures 5-2, 5-3)

TROUBLE	SYMPTOM	CAUSE	REMEDY
12. Passenger doors fail to operate on entire train.	Door control panel on a car inoperative.	Door override switch closed in operating cab.	Engineman release door override switch.
		Tripped door control circuit breaker either on that car or B car.	Reset circuit breaker in vestibule circuit breaker panel.
		No motion panel tripped on single car or B car.	Press no motion reset in No. 2 electric locker.
		Defective door control panel.	Operate doors from next car or pair of cars.
13. Passenger doors fail to operate on section of train.	Exterior door indicating lights lit on portion of train.	At dividing point in train where doors are open on one car and closed on another check for:	
		Door trainline switch in vestibule trainline panel on either car is cutout.	Turn switch to THRU-ON position.

TROUBLE	SYMPTOM	CAUSE	REMEDY
		Key in door control panel on either car.	Remove key.
		Coupler electric head retracted on either car.	Release electric head.
14. Doors fail to operate on one car or pair of cars. (If last car or pair of cars in train, refer to para 13 also).		No motion panel tripped on single car or B car.	Press no motion reset in No. 2 electric locker.
		Tripped door control circuit breaker.	Reset circuit breaker in vestibule circuit breaker panel.
		Tripped door motor circuit breaker.	Reset circuit breaker in vestibule circuit breaker panel.
15. Individual door fails to operate.		Open access panel to door operator assembly and check for:	
		By-pass switch turned off.	Turn switch on.

TROUBLE	SYMPTOM	CAUSE	REMEDY
		Emergency release handle in unlock position.	Place handle in lock position.
		Electrical or mechanical problems.	Turn by-pass switch off and manually close door or use emergency handle to open door.
		Trap door not either completely open or not completely closed.	Open or close trap door completely.

NOTE

"IN CASE OF EMERGENCY EXIT"

An inoperative side passenger door can be opened manually be moving the Emergency Release Handle to the unlock position. This red handle is located on the door operator assembly inside a panel in the passenger compartment side wall. Access to the Emergency Release Handle is through a hinged door in the wall.

D. FIRE EXTINGUISHERS AND SAFETY EQUIPMENT (Figures 1-3, 1-5, 1-7)

1. Fire Extinguisher

One fire extinguisher of the dry chemical, stored pressure type, is mounted adjacent to the mechanical hand brake in the B end vestibule of each car.

2. Emergency tools

A set of emergency tools in a case with a breakable clear plastic front panel is located under the aisle seat, right side, just back of the clean air duct on each car. The set of tools consists of a sledge hammer, a three foot wrecking bar and an axe.

3. Emergency Lights

Emergency incandescent lights are located in the ceiling of the car at appropriate places. Should the fluorescent lighting fail because of an interruption in power, the emergency lights will come on. Vestibule ceiling lights are also on the 38 VDC circuit and will remain on in the event of power interruption.

4. Hand Brakes

   Handbrakes are provided on the B end truck of each car and apply one shoe per axle.

5. Conductor's Brake Valve

   There is a Conductor's brake valve just inside the body end door at each end of the car. Pulling the conductor's valve causes a pneumatic emergency brake application.

6. Emergency Escape Windows

   There are four emergency escape windows per car, two on each side. There is one at each end and one near the center on opposite sides. To open an emergency window:

   a. Pull the handle on the rubber filler strip out and remove the entire filler strip from around the window.

   b. Pull the second handle, bolted to the window, and pull the window out of the rubber glazing strip.

   c. Turn and push window through the opening. The car may then be exited through the opening.

7. Pantograph Pole

A 20 foot pantograph pole is stored on the outside underfloor of each single car and B car, right side in the middle of the car. If the pantograph cannot be lowered in the normal manner, the pole may be hooked in the pantograph arcing horn and the pantograph pulled down manually to the latched position.

CAUTION: Keep pole against side of car until pantograph shoe has been pulled clear of the wire.

NOTE: The pantograph pole may be used to manually unlatch the pantograph to allow the pantograph to rise.

8. Pantograph Manual Raising Pump

The pantograph manual pump is located at the end of the pantograph pole, outside underfloor, in the middle of the car. If the pantograph cannot be raised in the normal manner, pumping the handle of the pump will build up sufficient air pressure to release the hold down lock. This allows the pantograph to rise by normal spring pressure.

NOTE: Three way cock adjacent to pantograph pump must be placed in the MANUAL position before operating the pantograph manual pump. Normal position is AUTOMATIC.

E. COUPLING TO A LOCOMOTIVE

A coupler adapter is carried in a bracket at the B end of the cars. The coupler adapter is an assembly which mounts on the car automatic coupler. The adapter provides a closed knuckle to which a locomotive can be coupled in a conventional manner using the knuckle of the locomotive. The adapter has both pin and socket connections to permit firm attachment to the automatic coupler. A latch key is inserted vertically in the knuckle of the adapter to grip the notched pin on the automatic coupler. This key is secured to the adapter by a short length of chain.

1. Place the brake valve handle in EMERGENCY then remove the handle by lifting up, moving it to the SERVICE position and lifting it out.
2. Place the cut-off valve on the brake valve to the CUTOUT position.
3. Remove the control plug.

   NOTE: All brake valve cut-off valves must be in the CUTOUT position. Control plugs must be removed.
4. Remove the coupler adapter from its bracket.
5. Lift the key out of the adapter.

6. Insert the adapter in the coupler as far as it will go.
7. Restore the retainer plate and wing bolts to the storage bracket.
8. Open the knuckle on the standard coupler (locomotives).
9. Couple up. The locomotive will push the adapter into its locking position.
10. Insert the key in the adapter.

    NOTE: The locking pin on the automatic coupler must be retracted using the pneumatic uncoupling button or the manual release bolt when removing the adapter.

11. Attach the locomotive air hose to the flexible air hose (gladhand) on coupled car.
12. Open the cut-out cock on the flexible air hose to obtain brake pipe pressure.
13. Test the brakes when brake pipe pressure is fully obtained.
14. Check that all handbrakes are released before moving cars.

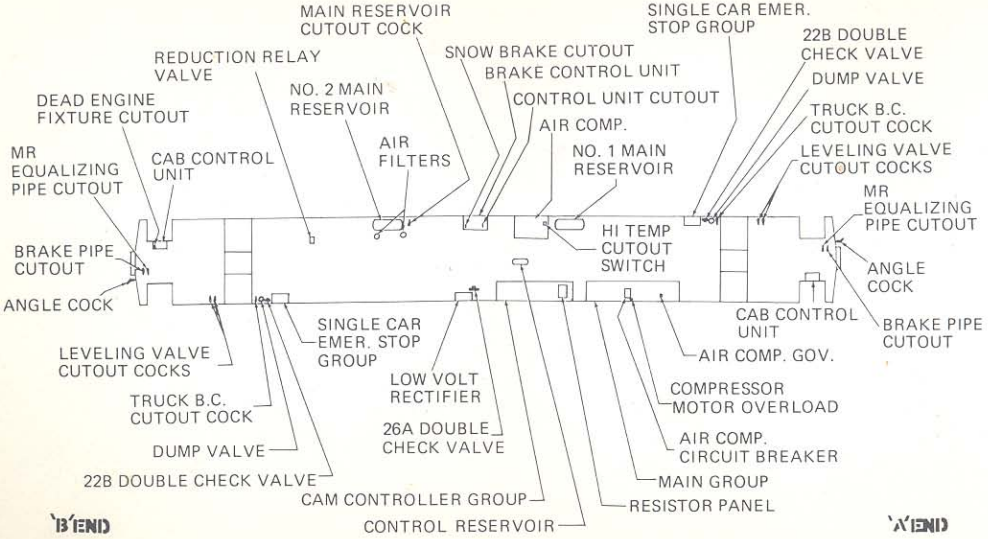


FIG. 5-1. BRAKE EQUIPMENT UNDERFLOOR LAYOUT SEPTA SINGLE CAR. E-18813

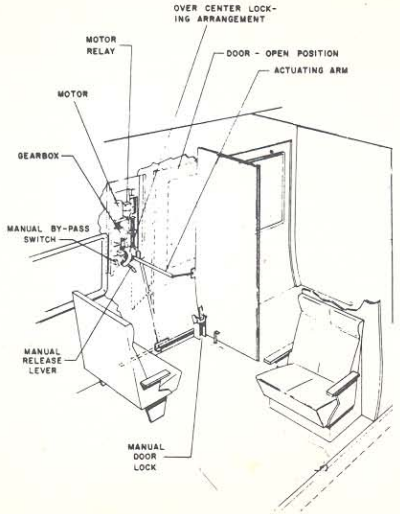


FIG. 5-2. DOOR OPERATOR - SHOWING LOCATION IN CAR.

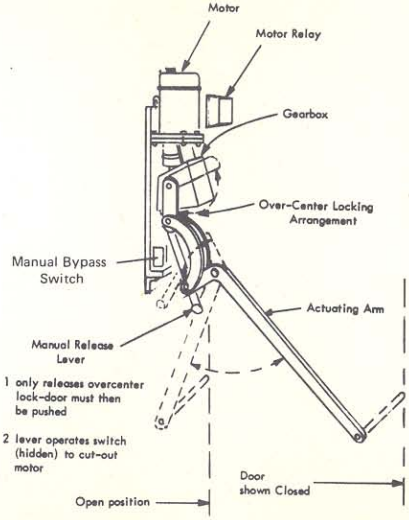


FIG. 5-3. DOOR OPERATOR.

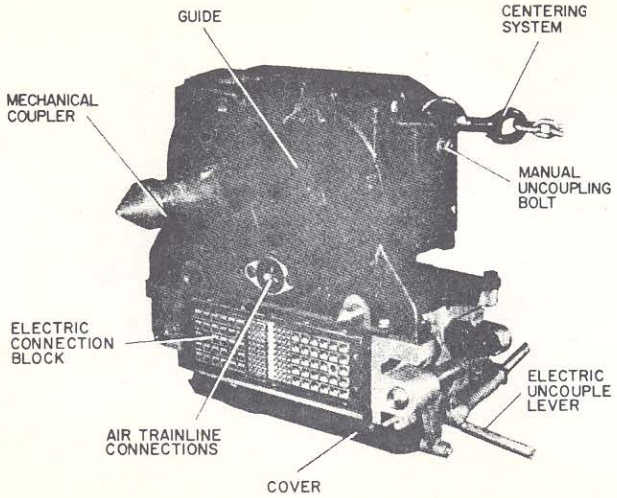


FIG. 5-4. N-2 COUPLER.

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